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PAG BULLETIN

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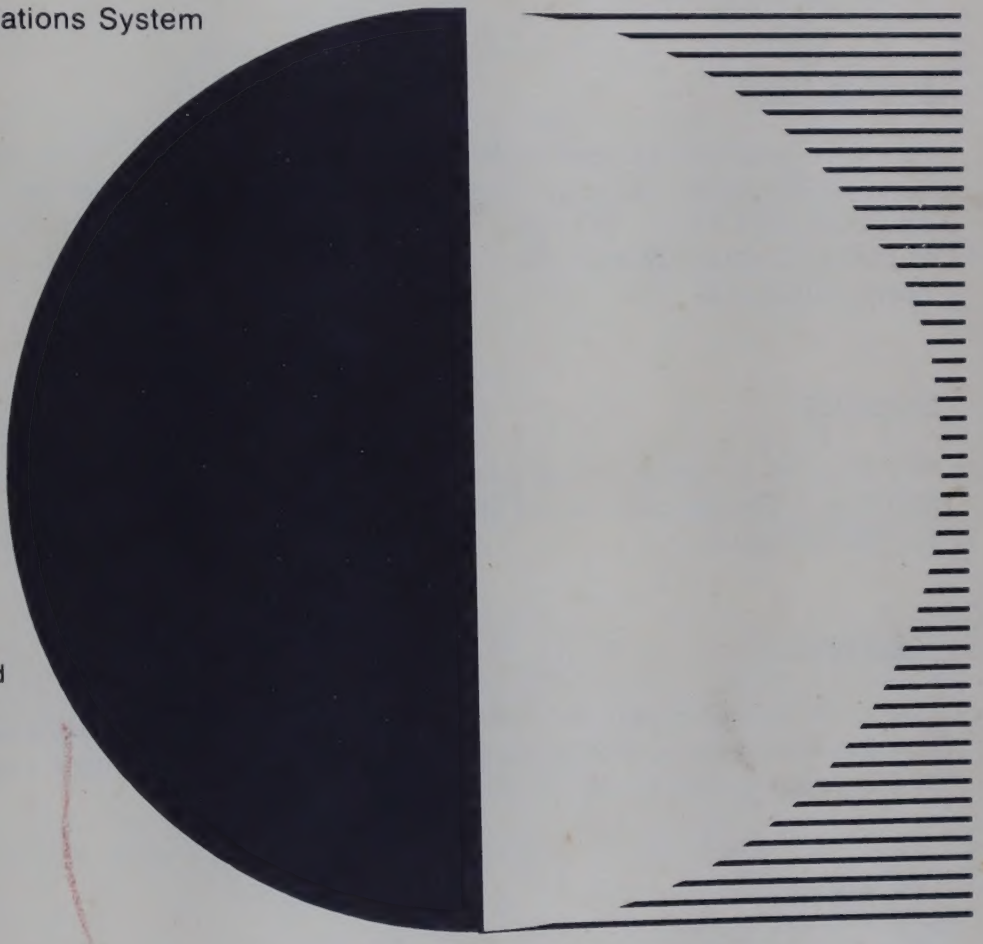

Food and Agriculture Organization of the United Nations
Rome

World Health Organization
Geneva

United Nations Childrens Fund
New York

International Bank for Reconstruction and Development
Washington

United Nations
New York

THE PAG BULLETIN

Purpose

The PAG Bulletin is published by the Protein Advisory Group of the United Nations System. Its purpose is to give information on the world protein problem to those individuals, academic institutions and industrial organizations which are interested in helping solve the protein problem and to promote the exchange of information in this field.

Mailing list

The PAG Bulletin is sent without charge to persons, organizations, and companies with an active interest in proteins. Requests to be added to the mailing list for the PAG Bulletin should be addressed to the Director of Secretariat, Protein Advisory Group of the United Nations System, United Nations, N.Y. 10017, U.S.A. Recipients are urged to share their copy with their colleagues.

Quotation

Permission to quote items from the PAG Bulletin is not required except from authors of signed articles. The Secretariat of the PAG would appreciate being informed of quotations made from the PAG Bulletin.

Suggestions

The PAG Bulletin will be successful only if it reflects all aspects of the protein problem comprehensively and objectively. The Secretariat invites suggestions and ideas for broadening and deepening the scope of the PAG Bulletin.

Secretariat

Staff members of the PAG Secretariat are:

Mr. Max Milner	Scientific Secretary and Director of Secretariat
Dr. P. S. Venkatachalam	Assistant Secretary
Mrs. Charlotte S. Kouris	Editorial Assistant
Mrs. Rosanne Burgaretta	Clerical Secretary
Miss Milena Peluchova	Clerical Secretary
Mrs. Mary Toumayan	Clerical Secretary

IN THIS ISSUE .....

TWENTY - FIRST MEETING OF PAG, NEW YORK, JUNE 1973

The 21st Session of the PAG was held at UN Headquarters, New York, 4-8 June 1973, under the Chairmanship of Professor N. S. Scrimshaw, with forty participants. Representatives from the sponsoring agencies, FAO (Food and Agriculture Organization), WHO (World Health Organization), UNICEF (United Nations Children's Fund), IBRD (International Bank for Reconstruction and Development) and the UN took part in the meeting, together with representatives from IAEA (International Atomic Energy Agency), UNIDO (United Nations Industrial Development Organization), UNDP (United Nations Development Programme) and Unesco (United Nations Educational, Scientific and Cultural Organization). Ten consultants joined in the deliberations on specific subjects. A special ceremony to honor the pioneer members of the PAG was held during the first plenary session on the morning of 4 June. Professor William Darby, Professor and Mrs. Paul Gyorgy, Professor William Sebrell and Professor and Mrs. Charles Glen King graced the occasion.

Following the opening of the meeting by Mr. Mr. Henry Labouisse, Executive Director of UNICEF, the special session to honor the pioneer members was held, with a welcoming speech by the Chairman, Professor N. S. Scrimshaw, who outlined the history and impact of PAG and the special contributions made by the pioneering members.* Responding on behalf of the pioneer members*, Professor William Darby described the initial efforts which led to the establishment of PAG and how the early activities were undertaken without any financial support from the sponsors. He mentioned that the most significant contribution of the PAG at that time was demonstration that the problem of protein-calorie malnutrition could be prevented by using, after suitable preparation, a wide variety of plant foods of local origin. Noting that the deliberations of the PAG have become wider, covering food production, distribution, marketing, food and nutrition policy, etc., Professor Darby stated that this widening scope of discussion has stimulated more effective coordination and joint programming between various UN agencies. The function came to a close with a vote of thanks to the pioneering members.

Mass communication in nutrition improvement

The PAG noted that mass communication in nutrition improvement is one aspect of a broader program of nutrition education and that this broad concept must be kept in the forefront in developing strategies and evaluating programs. There was divergence of opinion regarding the real value of communication through mass media such as radio, television, etc. It was concluded that the different media may have specific roles in different situations and in different countries and general recommendations applicable to all cannot be made. The approach and form should be selected after careful analysis of the area, people, facilities and the purpose. The need was expressed to consult at all stages with the population for whom the message is intended, to make use of the existing internal communication systems and to provide communication as a two-step operation. The first step is to influence leaders who in turn can translate the message into the words, thinking and feelings of the community. The importance of undertaking research and evaluation using local personnel was highlighted, with external contributions limited to the minimum necessary for developing techniques only. Other points made were the importance of quality and content of the message, the establishment of follow-up action soon after inducing awareness and the need for pilot studies. Based on the discussions, the PAG prepared a statement, "Mass communication in nutrition education" (to appear in a later issue of the Bulletin), and also recommended the establishment of an ad hoc working group to examine critically

*The other two pioneer members were Professor Emmet Holt, who was not able to be present, and the late Professor Benjamin S. Platt.

the important issues before drawing up strategies and guidelines for use of mass communication in nutrition improvement.

New information on world protein supplies: current trends

In addition to the growth of world population in the face of continuous adverse circumstances for food productivity, the emergence of affluence has become another claimant on world food resources. The PAG was aware of this trend as early as 1970, when it had an opportunity to review and comment on the FAO's Indicative World Plan on food production.

There was a difference of opinion on whether this increasing demand in the affluent countries for animal protein, particularly meat, which has led to a worldwide increase in the price of these products and the feed grains required to produce them, will, on the basis of export demand for the products, generate more income, more employment and better and more adequate food for the rural subsistence population in developing countries where the problem of malnutrition is serious. A majority felt that the increased income from this source would not "trickle down" enough to compensate for the higher prices of foods of animal origin.

Other probable causes for the rise in cost of farm products around the world were noted to be the cyclical occurrence of droughts, the instability of world currencies following devaluation of the U.S. dollar and the increasing problem of pollution. Some of the steps suggested to arrest and reverse this trend were: a cooperative global approach to food production, marketing and distribution; rapid exploitation of the unrealized potential for food production in developing countries; removal of production constraints while simultaneously protecting and preserving environmental resources such as fresh water, soil, fertility, etc., and converting agricultural research developments more rapidly into production breakthroughs; building up a significant global food-grain buffer stock; long-term research on alternative methods of food production to overcome dependence solely on traditional agriculture; suitable education to bring about a reduction in dietary consumption of meat as is being done in the case of fats; research and development on unconventional proteins such as single cell protein; and support to family planning programs.

Based on the discussion, the PAG prepared a statement, which is reproduced on page 10.

Food and nutritional considerations in national economic planning

Although human development is inseparable from economic development there exists the strange dilemma of nutritional objectives struggling to achieve a priority for national resources. The causes are threefold: inability to provide a quantitative justification so that the planners can assess the return in development benefits per unit of investment in nutrition; a lack of specificity in qualitative terms of the types of programs required and the time frame for results to become visible; and lastly, the provision by advisers of conflicting advice and emphasis.

The importance of basic data on food production, distribution and consumption and the need to examine the relative cost effectiveness of different programs to achieve their goals were stressed. Collaboration among all relevant sectors is necessary to enable clear analysis and follow-through of the contributions each could make toward nutritional improvement. The role of PAG in terms of the form of help and guidance in the development of nutrition policy it can provide whenever sought by governments was considered. The nutritional component of policy and planning in India and its implementation in the successive five-year plans, the problems encountered and the efforts to overcome them were reviewed. Similar programs and plans in Brazil and other Latin-American countries were briefly mentioned. The importance of planning and follow-through action even with minimum data was emphasized. The risks or pitfalls of macroplanning on a countrywide scale and failure to appreciate the relevance of microplanning at the rural community level was brought out.

Other points referred to were the choice of instruments for achieving nutritional objectives, particularly indirect ones like provision of

employment for low-income groups of the population, package plans and programs, development of agroindustries, payment of part of wages in kind, etc. It was stressed that projects should not be taken up in bits and pieces but rather be considered in a systematic, interrelated and comprehensive fashion.

Stressing the desirability of encouraging systematic long-range nutrition planning and short-range operational programs in a mutually-reinforcing manner, the PAG recommended the appointment of a working group to examine and prepare guidelines useful to planners. The PAG also prepared a statement on the subject.

Production and utilization of milk and milk products in developing countries

A review of observations and experience in several developing countries showed that in spite of great difficulties, the milk production outlook in such countries was generally promising. The farmer should be helped to increase output and consumer education should be fostered to stimulate milk consumption. The PAG made several suggestions in this connection. Long-term planning should take into account local ecological conditions, food habits and traditions relevant to milk and milk products and efforts to utilize available food resources for preparation of approved milk substitutes whenever the need exists, but without inhibiting animal milk production.

Some unconventional proteins: a progress report

a) Coconut flour as a potential food resource

Many developing countries with serious nutrition problems are located in tropical zones where coconuts are abundant. Satisfactory processing of coconuts to recover protein-rich flour for human consumption, along with edible oil, has not been achieved because of traditional emphasis on copra, which is prepared under poor sanitary conditions and is partially decomposed. Among the food-grade processes, the wet extraction process, using fresh coconut meat, yields a full-fat "milk" of good nutritional and sanitary quality. However, this product, which can be spray-dried, is expensive. The PAG noted with interest the development of a prepress - solvent extraction process in the Philippines which yields a low-cost, 65% protein concentrate from fresh coconut meat obtained from mature nuts. It can be prepared either from the trimmings obtained prior to desiccation and shredding of fresh coconut meat for export or from any fresh excess coconut meat which has no immediate market. It also makes available a high-grade coconut oil for domestic use or export. The Secretariat was asked to obtain complete details of this process, including cost estimates, to prepare appropriate guidelines and to disseminate this information widely.

b) Rapeseed protein concentrate for human consumption

The PAG noted that encouraging progress has been achieved in Sweden in the development of an industrial technology for producing an edible, toxin-free protein concentrate from the defatted residue, and that this product will soon begin to make an impact on the protein needs of some industrial countries. Although rapeseed is a temperate-climate crop which cannot be easily grown in tropical latitudes, its availability for human food use might be helpful in mitigating protein food shortages in international markets. Mustard seed, which is also a Brassica species grown widely as an oilseed crop in India, may also benefit from this technology. The new technology might also have application to other oilseed materials indigenous to developing countries in tropical and subtropical areas.

Textured vegetable proteins

The texturizing of vegetable proteins to provide meat-like foods is a new and rapidly-growing commercial operation in North America, Europe and Japan. Simple products based on the extrusion-expansion of a paste of soybean or other legume flour is the most rapidly-expanding application. Its primary appeal to consumers is the lower cost of meat products, e.g. ground beef, in which as much as 30% of the hydrated vegetable protein is admixed. Regulations and standards applying to such mixed products are at present under consideration in many countries. These controls should be formulated to protect

the consumer, but should not in any way inhibit this desirable development. The more sophisticated technology based on fiber spinning, which yields textured products even more like meat, will no doubt be increasingly utilized as the world price of meat continues to rise. These developments will make a useful contribution to meeting the world demand for protein foods. The economics of extrusion technology is such that its early adoption in certain developing countries can be anticipated.

Other items for discussion

Some of the other items on the agenda considered by the PAG were the reports of three PAG ad hoc Working Group meetings: feeding the preschool child, December 1972; planning evaluation of supplementary feeding programs, March 1973; and single cell protein, June 1 and 2, 1973; development and presentation of model research projects and a review of activities of the Technical Advisory Committee of the Consultative Group on International Agricultural Research.

MEETING OF EXPERT GROUP TO PLAN EVALUATION OF SUPPLEMENTARY FEEDING PROGRAMS

This meeting was held at FAO Headquarters, Rome, on 28 and 29 March 1973, as a result of a PAG recommendation that: "... the evaluation, whose ultimate objective is to produce a guideline of supplementary feeding policies and procedures useful to governments and international agencies, should cover programs for school children, preschool children and mothers. A small working group ... would examine all the available data, formulate the scope, working plan and time schedule for the evaluation, and draw up terms of reference for the consultant who may be appointed to carry out the recommendations. The recommendations of the group will be placed before the 21st Session of PAG." There were nine participants*.

The group first reviewed current supplementary feeding programs and their shortcomings. It noted the insufficiency of background data and inadequate reporting of results. It was generally agreed that any effective program should be based on knowledge of the agricultural potential and nutritional possibilities of the area or region affected; the food consumption and nutrient requirements of different socio-economic, age and sex groups within the population and within households; clinical data on nutritional deficiencies; and standards of adequate diets in relation to various climates, occupations and body sizes. Strategies of intervention and the impact of these interventions can then be more accurately assessed and more efficient delivery systems developed for the target groups as defined by such knowledge.

The ultimate purpose of evaluation is to understand clearly the realistically-attainable goals of nutrition intervention programs. It is important to devise information systems which periodically and adequately monitor the program; this "feedback" may improve the delivery system.

As far as reporting goes, a thorough review of the available literature, conducted by USAID, reveals a paucity of evaluation data, particularly in the case of preschool children. For example, a number of reports, identified as "evaluations", used as measures of success the increase in numbers of children reached by the programs or the effectiveness of the

*The expert group consisted of Dr. B. M. Nicol, FAO (Chairman); Mr. Prodipto Roy, India; Mr. M. Forman, USAID; Dr. J. Gongóra y Lopez, WFP; Mr. H. Ruthenberg, PAG; Dr. E. M. DeMaeyer, WHO; and Mr. M. Milner, PAG Secretariat. Also participating were Miss M. Forrestière, WFP; and Mr. A. Dawson, WFP (part-time).

distribution system rather than the impact of the program on the recipients.

The group drew up a list of eleven objectives and criteria for evaluation of feeding programs. They included improvement of physical and mental development of children through better nutrition; nutrition education of children and their families; improvement of maternal and child health in order to promote optimum fetal development and good infant health at birth and to stimulate effective lactation; improvement of learning efficiency; increase in school attendance and enrollment, and reduction of dropouts; subsidization of family income; promotion of new patterns of food consumption, thus supporting agriculture; promotion of new types of food processing and consumption of such new foods; strengthening food marketing and delivery systems; training and strengthening administrative infrastructure; and achievement of political benefits of concern to governments. It was agreed that for the pre-school child and pregnant and lactating women, the first three are the most important, with the fourth and fifth objectives added for the primary schhol child. Criteria for the measurement of these objectives, both direct and indirect, were discussed.

Other topics considered by the group were program costs, analysis of the financial aspects of a feeding program, evaluation of organizational effectiveness and utility of pilot studies to test evaluation methodologies.

In conclusion, the group recommended the appointment of two consultants to further develop and test the proposed evaluation methodology in selected feeding programs.

PAG PEDIATRICIAN / INFANT FOOD INDUSTRY SEMINAR

Under the auspices of the PAG, a pediatrician/infant food industry seminar was held on 11 June 1973 in New York under the co-chairmanship of Dr. N. S. Scrimshaw, Chairman of the PAG, and Mr. David O. Cox, President of Ross Laboratories, Columbus, Ohio. The seminar was attended by twenty-eight participants*. The objective of the seminar was to review the recommendations made in PAG Statement No. 23, "Promotion of processed protein foods for vulnerable groups", issued following a similar meeting convened in Paris, France, in June 1972 (See PAG Bulletin Vol. II, No. 3, 1972, p. 10), and to determine specific action to be taken on recommendations 3 and 4 directed to pediatricians and the industry respectively. A series of specific proposals for integrating industry efforts into national health care activities was offered for discussion and the group recommended as a first priority the preparation of a suitable curriculum for use in the training of sales personnel and mother-craft program operators and testing it in a few centers in different parts of the world.

Since the international networks of commercial firms are widely spread, it was felt necessary to review and discuss these ideas first at

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*PAG members: Dr. N. S. Scrimshaw, U.S.A.; Mr. O. Ballarin, Brazil; and Dr. B. Vahlquist, Sweden.
PAG consultants: Dr. C. Aall, Norway; Dr. D. B. Coursin, U.S.A.; Mr. A. Fuglesang, Ethiopia; Dr. D. B. Jelliffe, U.S.A.; Dr. M. Latham, U.S.A.; and Dr. M. I. Ogbeide, Nigeria.
Infant food industry representatives: Mr. M. Beigler, Syntex; Mr. D. Cox and Mr. D. Benton, Ross Laboratories; Mr. R. Drebus and Mr. R. W. Scerbo, Bristol-Myers; Mr. H. P. Sarett, Mead Johnson; Mr. J. Miller, Abbott; and Mr. T. J. Patton and Dr. T. Christie, Wyeth, all from the U.S.A.; and Mr. R. Tudor-Price, Cow & Gate, Canada.
International Paediatric Association: Dr. H. L. Barnett.
UN agencies: WHO and UNICEF.

regional (or national) councils so that local interests concerned can obtain necessary clarification. The need for educating other groups of individuals such as family, physicians, pediatricians, medical students, government auxiliary health staff, etc., who are in a position to influence mothers with regard to infant feeding, was stressed once again. Since commercial firms concerned with infant feeding always work in close collaboration with the medical profession of the country, educating doctors in current nutritional principles as applicable to local ecology becomes imperative. The need for continuing research in the area of infant feeding practices and the changing trends in this in different parts of the world and on the factors responsible was emphasized. The Secretariat will follow up on several suggestions that came out of the seminar.

THIRD MEETING OF THE PAG AD HOC WORKING GROUP ON SINGLE CELL PROTEIN (SCP)

This ad hoc Group met on 1 and 2 June 1973 in Cambridge, Mass., U.S.A., immediately following the MIT International Conference on SCP, which provided an up-to-date review of the latest information on various aspects of this rapidly developing technology. There were twelve participants*.

Among the new developments which the group noted were a project being conducted by Tate & Lyle (United Kingdom) for the utilization of carob bean, involving a fermentation step to produce SCP for animal feeding; a new process developed by the Imperial Chemical Industries (United Kingdom) to produce bacterial protein from methanol; the Finnish "PEKILO" protein project utilizing bisulfite spent liquors from pulp mills to propagate and recover a highly mycelial fungus for animal feeding; new developments at the Lord Rank Research Centre on animal and clinical testing of their filamentous microfungal "textured" protein product; and the most recent compositional and testing data from the British Petroleum Co. on Candida yeast grown on gas oil at Marseilles, as well as for a similar species produced in Scotland on highly purified n-alkanes. Information on a very extensive program in the U.S.S.R. to screen a variety of SCP products for nutritional value and toxicity in animals was presented, including observations on humans fed livestock products produced with these SCP materials.

Information was given on the intention of Liquichimica Biosintese of Italy to construct a 100,000 tons per year plant in Sicily to produce SCP from purified petroleum using the Kanegafuchi process and on the announcement by British Petroleum of building a plant of similar capacity in Sardinia. Several interesting developments on producing SCP from animal and other wastes were reported.

Detailed information is now available from French and Mexican studies on the nutritional qualities and freedom from toxicity of Spirulina (fungal protein) when fed to animals and humans.

Based on these reports the ad hoc Group, in its report, commented on the suitability of SCP

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* ad hoc Group: Dr. A. A. Pokrovsky (Chairman), U.S.S.R.; Professor N. S. Scrimshaw (Vice-Chairman), U.S.A.; Mr. A. E. Humphrey, U.S.A.; Mr. B. L. Oser, U.S.A.; Mr. J. C. Senez, France; and Mr. S. R. Tannenbaum (consultant), U.S.A.
PAG: Mr. K. Yamada, Japan.
Collaborators: Mr. A. F. Langlykke, IUPAC; and Mr. P. Mechelynck, EEC.
UN agencies: FAO and WHO.

for human consumption and on the present feasibility of production of SCP in developing countries. It proposed new procedures for assessment of protein value and for strengthening collaboration with the European Economic Community and the International Union of Pure and Applied Chemistry. It also commented on recent developments in Japan where, under pressure from consumer groups, the Ministry of Health withdrew operating licenses of firms developing SCP products.

The rapid rate of development of technology in this field, stimulated by increasing demand for meat and other animal products, will require even more intensive surveillance of the field by the ad hoc Group. Its report was approved at the 21st Meeting of the PAG and will be available for distribution shortly.

LEGISLATION FOR THE PROTECTION OF WORKING WOMEN DURING PREGNANCY AND LACTATION*

The purpose of legislation for maternal protection is to benefit both the mother and the young infant. Leave during the last part of gestation offers protection against premature delivery and leave after delivery provides rest and convalescence for the mother and helps her to take care of the infant in many ways, including breast feeding. Successful lactation and breast feeding may also act to a certain extent as a natural contraceptive.

In developing countries breast feeding is fundamental, since it safeguards the infant's health through both adequate nutrition and protection against infection. The young infant receives the best care and emotional stimulus through constant contact with its mother which is necessary for proper development of personality in later life.

Nutritional vulnerability of working women and their children

Pregnancy is a nutritional strain on the woman, the more so if it is repeated at short intervals. There is ample clinical and experimental evidence to demonstrate that poor nutrition of the pregnant woman has an adverse effect not only on the mother herself but also on her unborn child.

Poor nutrition during pregnancy, and subsequently during lactation, may also adversely affect the capacity of the mother to breast feed her baby. Under poor hygienic and economic conditions, such as those prevailing today for a majority of the population in most developing countries, complete breast feeding during the first four to six months of life and partial breast feeding up to twelve months or longer is of paramount importance. Any factor interfering with breast feeding may have serious effects, such as high morbidity and mortality in the young child and the risk of long-term developmental defects in the survivors.

Under the influence of Western culture, a decline in breast feeding has been observed lately in many developing countries. Urbanization and changing technology have contributed to this by increasing employment of women outside the home. The potentially serious results of this development for the young child must be carefully observed and assessed to protect the working woman's health during pregnancy and to provide her all facilities for nursing her baby after delivery. These considerations provided the overall motivation for discussion on the subject of legislation and for drawing up

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*Excerpt from the report of a meeting of the PAG ad hoc Working Group on Feeding the Preschool Child, held in Geneva, 11-13 December 1972 (PAG Bulletin Vol. III, No. 1).

recommendations.

The dangers of early weaning

In a technically-developed country, early weaning (from birth to six months of age) today does not imply any great danger to the infant since formulas which satisfy the nutritional needs of this particular age group are available and the mothers are informed on their proper use. There are other reasons, however, even in developed countries, for the emphasis given to measures providing women employees with special leave in the pre- and postpartum period. This has to do with a wish to preserve the mother-child relationship and thus lay the foundation for future harmonious emotional development. For the majority of the population in a developing country, from a nutritional point of view, the situation is completely different. Inexpensive, nutritious formulas are rarely available and there is no guarantee of their hygienic handling; under these conditions early weaning is an overwhelming threat to the health and life of the young child.

From the foregoing it should be clear that a great effort is needed to protect mother and child through pertinent legislation and that this is true both for the developed and for the developing countries. One further argument for this attitude could be added, as far as the developing countries are concerned. If the ill effects of early weaning were counteracted to some extent, this would save the importation of infant formulas with the corresponding loss of foreign exchange.

International Labour Organisation (ILO) conventions and legislation on maternity protection

The group observed that great efforts are being made to improve the standards and availability of infant foods now on the market. However, few concrete measures have been taken to promote breast feeding. The relevant ILO Conventions (Nos. 3 and 103) and Recommendation (No. 95) relating to maternity protection, which embody a coherent set of standards, have been ratified by a relatively small number of countries. It was recognized that nonratification did not necessarily imply that measures provided for in the Conventions (prenatal and postnatal maternity leave, maternity benefits, facilities for nursing mothers to breast feed their infants, etc.) were not applied in that particular country. Some had in fact instituted beneficial measures beyond those prescribed in the Conventions and Recommendation, particularly as regards the extension of paid maternity leave, permitting the mother to remain at home with her infant, if she so desired, without prejudice to her employment rights and benefits. On the whole, however, the impact of measures taken for maternal protection, legislative or otherwise, in many countries, including technically-advanced ones, still leaves much to be desired.

Some of the legislative measures which have been taken to promote breast feeding are the stipulation that midwives encourage mothers to breast feed and the provision that breast feeding is, except if medically contraindicated, an intrinsic obligation of the mother. The value of such regulations as a means of promoting breast feeding may be difficult to assess.

Maternity protection legislation should of necessity be framed in such a way as to avoid placing a heavy financial burden on the owner of a private undertaking. It would be undesirable to adopt provisions which would require maternity benefits to be paid mainly or entirely by such individual employers. Other ways, involving private insurance or governmental contribution on a tax basis, must be considered. The position in this regard is, of course, somewhat different in countries with a centrally-planned economy.

Duration of postnatal leave

From the point of view of the nutrition and health of the infant and the emotional aspects of the mother-child relationship, the first six months are crucial. The group strongly recommended that the duration fixed for postnatal leave take these factors into account.

Developing countries: the current status

In the developing countries a rapid disintegration of traditional patterns of society is taking place through the influx of large groups of the population to urban areas and the growing employment of women in industry. Appropriate legislative and other measures must be taken to deal with this growing problem which has far-reaching effects on maternal and child health.

Even where legislation already exists, failure of implementation may occur for various reasons; this is unfortunate because of the serious effects of malnutrition in early childhood. Nonimplementation of the provisions of the legislation will have even more harmful effects in this area than in other fields of health legislation. Where a gap in implementation exists, it is often difficult to narrow or to close it because of the prevailing socio-economic conditions.

Social measures outside legislation

Continuing education at all levels on matters of the health of mother and child can be of importance and the modern techniques available for this purpose should be used. It may help a great deal if female health professionals are stimulated to practice breast feeding themselves when they have a baby, so that they can serve as an example to the community. Education in regard to breast feeding should be given more emphasis in medical and nursing schools and in health education programs in general. Special attention should be given to the health care and health education, particularly in regard to nutrition and mother-craft, of pregnant women and nursing mothers.

The obligation to provide such care and education should rest with both the general and the occupational health services. The group noted that ILO standards, particularly those regarding the nature and conditions of work, provide certain guidelines in this area. In taking measures for maternity protection, both legislative and otherwise, it is essential to coordinate these with other maternal and child health legislation, notably that dealing with family planning.

Further studies

The group noted that compilation of all existing legislation in this area, including the details of all provisions and a world survey on the implementation of ILO's maternity protection standards, similar to those carried out in 1964 and 1965, would be of great value. In addition to a worldwide survey of this nature, it would be of interest to examine the historical background and to conduct case studies in depth of the actual implementation of legislation and other related measures pertaining to maternity protection and infant care in a limited number of countries.

General references

1. ILO. 1965. Report of the Committee of Experts on the Application of Conventions and Recommendations, Part III, Report III (Part IV). 49th Session of the International Labour Conference. The International Labour Office, Geneva, Switzerland.

2. WHO. 1952. Maternity care. Report of an Expert Committee. WHO Technical Report Series No. 51. World Health Organization, Geneva, Switzerland.

PAG STATEMENT (No. 25) ON THE GLOBAL MALDISTRIBUTION OF PROTEIN: A GROWING TREND*

At the 17th Session of PAG, May 1970, the group had an opportunity to comment on the FAO Indicative World Plan (IWP) for Agricultural Development. The comments from which the following extracts are reproduced were prepared for use in discussions at the Second World Food Congress.

" ... c) According to the IWP the effective demand for proteins, and especially for meat and fish, will not be covered by the supplies offered in the period considered; consequently, as stressed in the IWP, the demand hypothesis based on projections at constant prices is not likely to be realized for this type of product. Unless special measures are taken the demand in relation to available supplies will result in increases in prices. This will result in an increased deficit in consumption by the less-favored population groups...

" ... e) In general, the increase in demand for animal proteins which may be due to an increase in overall income may not improve the nutritional level of the groups which have the most urgent need. On the contrary, their situation may be aggravated.

" f) For a long time to come there will be a need for programs which will underline the importance of preserving proteins for those who have the highest need for them, inside the family, among various socioeconomic groups and between different ages and classes.

" g) The production of high-quality proteins, especially dairy products, should be encouraged where feasible in developing countries. In support of these projects, food aid programs will be of value to governments attempting to achieve a harmonious development of their economy with simultaneous improvement in the diet of the population ... "

Since then there has been a tremendous increase in the demand for animal feed in the face of continuous adverse circumstances for productivity. These factors have largely aggravated the trend described in the above paragraphs and the international market in 1973 is witnessing a phenomenal increase in price of man's principal food commodities, including wheat, rice and soybeans. These developments have evoked widespread concern for the nutritional status of the economically-handicapped sections of the world population. While historically the global food situation has been discussed largely as a population-food supply problem, we are now witnessing the emergence of rising affluence as a major new claimant on world food resources.

Over four-fifths of the annual increase in world population of an estimated 75 million occurs in poor countries, which are now struggling to find not only food but also opportunities for remunerative and productive employment for their fast-growing populations. In poor countries, which represent the majority of mankind, the per capita availability of grain averages about 190kg per year, most of which is consumed directly to meet minimum energy needs. In contrast, the per capita utilization of grain is currently approaching one ton per year in the United States and Canada; of this, only about 70kg are consumed directly in the form of bread and similar products, the rest being channelled through the plant-animal-man food chain.

The annual per capita consumption of beef has risen in the United States from 25kg in 1940 to 52kg in 1972. The same trend is seen in many countries in Western and Eastern Europe, the Soviet Union and Japan. As a result, an increasing proportion of the world's grain and oilseed production is utilized for feeding animals to

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*This statement was prepared following discussions held at the 21st PAG Meeting, 4-8 June 1973, New York. It is based on information presented by Mr. Lester Brown, Overseas Development Council, Washington, D.C., U.S.A.

meet the demand for animal products in affluent nations.

This power of affluence to attract and consume much of the world's food and feed grains, together with a stagnation in the world fish catch since 1969, the recent disappearance of the anchoveta off the coast of Peru and the weather-induced fall in rice and wheat production in several parts of the world during 1972, have led to the current price explosion in basic food items and thereby underlined the urgency of studying and influencing the growth of global agricultural production and consumption trends with regard to both short- and long-term factors.

The Protein Advisory Group views with concern the possible impact of the current food availability and price situation on the nutrition of the vulnerable groups of the developing countries and more particularly of the landless poor of such nations. It considers that action on the following points is urgently called for:

1. Implementation of the proposal of the Director-General of FAO for achieving "minimum world food security" through a system of coordinated national food reserve policies or through a nonpolitical world food bank.

2. Development of a global approach to the management of world fisheries, including limits on the catch of a number of species and their allocation among countries. The PAG hopes that the countries participating in the forthcoming UN Conference on the Law of the Sea will adopt a constructive approach and help to develop a global fisheries management system which can ensure sustained productivity of marine fisheries, avoidance of pollution and rational distribution of the fish catch. Simultaneously, the PAG urges all developing countries to increase their inland and near-shore fish production through the widespread dissemination of modern aquaculture and mariculture techniques.

3. Research on enhancing animal productivity and improving the yield potential of grain legumes and oilseeds should receive very high priority. In the United States, which produces 75% of the world's soybean crop and supplies 90% of all soybeans entering the world market, soybean yields per acre have increased only about 1% per year since 1950, while the yield of corn has increased by nearly 4% per year during the same period. It is such differential progress in technology which is now placing the food legumes at a disadvantage in cropping systems.

4. Developing countries, generally characterized by low yields per acre but abundant sunshine and favorable conditions for crop growth, offer exciting prospects for expanding food production. Some authorities believe that the current price explosion may be expected, in certain limited situations in a few countries, to lead to income redistribution in favor of poor peasant farmers and thus to nutritional betterment of their diets. However, past experience has shown that this expectation has not always come true, even in these restricted situations. The only solution seems to be that the developed countries should help, at least for some years to come, by providing supplies of inputs such as fertilizers, farm equipment, pumps and similar means of promoting scientific agriculture. These inputs will lead to a reduction in the cost of production, more opportunities for additional employment and an improvement in income and nutrition among the poorer segments of the populations. Particular attention should be paid to improving the foreign exchange earnings of the less developed countries through the export of both true surplus primary products and finished products manufactured by a well-developed system of agroindustries.

5. The PAG urges agricultural planners in the developed and developing countries to examine the need, ultimate scope and impact of further expansion of the plant-animal-man food chain, both through long-term assessment of the fodder, feed and water requirements of this chain and through a careful study of feasible alternatives including technological developments in the area of substitution of vegetable protein for animal protein. An example of this is the standardization of oilseed protein-based meat analogs and milk-like beverages.

6. Rising prices spell danger to the nutrition of a large majority of low-income urban

populations. The PAG urges national governments to develop systems of food distribution which will ensure the supply of the basic food needs of such vulnerable groups.

7. About 71% of mankind lives in developing countries where only about 44% of the world food supply is produced. The negative impact of the world livestock-feed demand on this population-food ratio calls for careful examination, and policies must be formulated which will not only prevent any adverse effect on the nutritional status of the people of developing nations but will also promote their rural and agricultural living standards.

PAG GUIDELINE (No. 7) FOR HUMAN TESTING OF SUPPLEMENTARY FOOD MIXTURES*

1. Applicability of the guideline

Tests for safety and suitability for human consumption, especially for feeding infants and children, are essential in the development of protein-rich foods. When commonly-used foods are newly processed to supply protein in a food mixture or when materials, not so far used as human food, are to be used as protein sources in a new food product, it is essential that certain preliminary steps be taken before testing the product in humans. Some of these steps are outlined in PAG Guideline No. 6(1) for preclinical testing of novel sources of protein.

Some preliminary steps are:

a) Identification of the source of edible protein, the quantity available and an economic study of its development.

b) Chemical evaluation of the quantity and quality of protein, if not already known, in each of the component foodstuffs from which protein-rich food mixtures are to be made.

c) Determination of various components in the proposed mixture based on considerations of nutritional or other relevant factors. An evaluation of the probable price of the final product would be desirable at this stage, taking into account the costs of raw materials, processing, packaging, storage conditions, shelf-life, commercialization, normal profits and all other elements which enter into the operation.

d) Measurement, chemically and biologically, of the nutritive value of the mixture and evaluation of damage to protein or loss of available nutrients as a result of processing which may be necessary for industrial production or final consumption.

e) Assurance that it is free from harmful microorganisms.

f) Testing for freedom of the product and its components from toxicity. Such toxicity may be due to the presence of intentional additives, of toxic substances naturally occurring or arising from mild infestation or through the use of pesticides and fungicides. Qualitative and quantitative tests for determination of these compounds may be necessary, as well as animal tests for determination of acute and subacute toxicity. The rules specified by the United States Food and Drug Administration for acceptance of additives to common foods provide useful guidelines (2). These include full acute and chronic toxicity trials.

It is only after these steps have been satisfactor accomplished that human tests should be considered. It is imperative, therefore, that all

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* This guideline, originally issued on 10 June 1970, was revised at the 20th PAG Meeting, June 1972, and issued on 7 November 1972.

the requirements mentioned above be fully satisfied before planning an undertaking which will involve human subjects.

While there is no question as to the need for the clinical testing of really new sources of protein or of the results of new ways of processing protein concentrates, there is a real danger that excessive and unnecessary testing of minor variations in formulas using previously-tested ingredients or processes could needlessly hamper progress in this field.

i. Products requiring full testing procedures, both preclinical (Guideline No. 6) and clinical (Guideline No. 7), are:

a) Processed or nonprocessed protein-containing foods which have not previously been considered in WHO/FAO/UNICEF testing programs.

b) Products previously considered as suitable, which have been subjected to different processing conditions which may raise questions regarding their nutritional or toxicological properties.

ii. Products requiring only limited clinical testing, acceptability/tolerance only, are staples and protein sources which are well-known or have been considered suitable in WHO/FAO/UNICEF programs and not subjected to processing which could cast doubts on their safety. It would be advisable, however, to ascertain the nutritional value, PER or NPU, of the final product by animal experimentation.

An understanding of the technological steps involved in the processing will help to decide in which of these categories a food mixture should be placed.

2. Categories of tests

Human testing, as these observations will be termed, will fall into four main categories:

a) Acceptability and tolerance tests
b) Growth tests
c) Nitrogen balance measurements
d) Other criteria

The actual types of tests to be carried out will be determined by the considerations mentioned below. Regular clinical observations will, of course, be concurrent in all studies. One prerequisite common to all is fully-satisfactory information on items a) to f) in Section 1.

2.1 Acceptability* and tolerance tests

It is possible that the foodstuffs from which a protein-rich food mixture is made have been in use individually as human food in one or more parts of the world. Processing of mixtures on an industrial scale, however, may affect not only their suitability for the groups for which they are intended, but also their palatability and acceptability. Therefore, it may be necessary to determine the tolerance to the dosage level recommended for a significant contribution to protein needs. Under such conditions, "acceptability and tolerance" tests are indicated. These tests should be carried out in an institution and in a closely-observed sample of the population. If it is decided to make several such tests of a given product, at least one of them should take place in the country for which the protein-rich food mixture is intended.

One danger to be avoided is that persons evaluating the food supplement may be swayed by their own "acceptability" criteria and thus influence the reaction of the recipient to the detriment of useful supplements. Even young infants sense the emotional reaction of the mother or of other persons feeding them and may respond psychically by rejecting the food.

Disease processes, and particularly even mild infections, tend to reduce appetite and produce mild to moderate gastrointestinal upsets, which could be interpreted as poor tolerance and acceptability. Because of these factors, it is suggested that a simultaneous control be run in these trials. Sequential periods with and

*This section deals with clinical acceptability as opposed to market acceptability (PAG Guideline No. 10).

without the test food may also be useful. The total volume fed, the timing of the meals and the total intake should be kept consistent. If possible, test and control groups should be of similar age and have similar weights for their heights. The subjects in both experimental and control groups should be interrogated daily to determine any occurrence of diarrhea, vomiting or other signs of intolerance.

2.1.1 Number. The number will vary depending on the consistency of the results. In any case, it is suggested that no less than twenty, and preferably closer to thirty, individuals be tested.

2.1.2 Age. The sample should consist of the age or ages for which the product is intended.

2.1.3 Duration of feeding and observation. Occasionally upon the introduction of a new type of food a short period of apparent intolerance may occur, and this may be overcome in the first week through gradual introduction of the new food. If the product has a flavor or texture which causes it to become tiring or unacceptable with continual use, this is generally noted within the first weeks of the feeding trials. It is therefore suggested that a period of at least four weeks elapse before the clinical evaluation of protein quality or more extended tolerance tests are carried out.

2.1.4 Method of preparation. This should be in the form of a suitably-flavored gruel or be incorporated into a local recipe.

Even if acceptability is unsatisfactory when first tested, it may be possible to find an acceptable form of preparation, by trial and error, with the same types of subjects chosen for the first test. The method of preparation should be such as is practicable in homes and under conditions for which the food mixture is recommended.

2.1.5 Level of protein feeding. This level is that needed to supplement the diet to the levels recommended by the FAO/WHO report on protein requirements (3) or preferably to attain 50% or more of the FAO/WHO recommended safe levels for the age of the subjects. An additional group fed the material ad libitum will provide information on maximum quantities acceptable per meal in the form supplied.

2.1.6 Level of caloric intake. This should be sufficient to maintain constant weight in adults or adequate weight gain in children (3). For children previously malnourished, 120-150 cal/kg/day may be necessary.

2.1.7 Observations to be made. Children should be left to feed themselves or should be helped by an attendant, but in this case care should be taken not to force the food on the child. Refusal to eat the preparation is considered an indicator of poor palatability, provided that the trials take into careful consideration all of the potential interfering factors in this type of study.

Tolerance is judged by noting persistent gastrointestinal upsets, such as loss of appetite, flatulence, vomiting (particularly delayed vomiting), undigested stool contents, intestinal hurry and diarrhea. Where legumes are involved, it is important to note the extent of bloating and flatus production. Possible intolerance to lactose should be kept in mind.

Other clinical manifestations such as allergic reactions should also be recorded if shown.

Large-scale, 3- to 6-month acceptability and marketing* trials in selected future consumer groups should be started as soon as possible after this step. Careful consideration should be given to the statistical design and evaluation of these trials.

When protein-rich foods are introduced to the family, observations should include the reaction of mothers to the products. It should be explained to them that although the food will contribute to the nutrition of all the members of the family, it has been prepared in a form which is of

* PAG Guideline No. 10: Marketing of protein-rich foods in developing countries.

special value for the health and development of infants and young children.

2.2 Growth tests

The principal methods used for the evaluation of protein quality in man are measurement of growth and of nitrogen balance. These represent alternate approaches; which will be selected depends upon many factors, such as the type of subject to be studied, the local conditions, the facilities and the personnel available. It is desirable but not essential that they be done in the country of intended use. Complementary information may also be obtained by various types of measurements of blood chemistry and liver function. Both growth tests and nitrogen balance techniques should be carried out only in centers specialized in nutrition or allied disciplines. The use of tolerance and acceptability experiments to evaluate the effect on growth should be discouraged, but weight should be registered during these tests as an additional indicator of tolerance.

2.2.1 Growth. Trials in which growth is measured may be planned in many ways, depending upon the nature and age of the subjects to be studied and the circumstances in each case. Therefore, only very broad outlines can be laid down. Every trial should be planned on a sound statistical basis and it is essential that a closely-matched control group be incorporated in the study.

2.2.2 Observations which may be made. The most commonly-used index of growth is the rate of gain in body weight. Evaluation of protein value from the change in weight over a specified period on a given protein intake is analogous to the measurement of PER in animals and is subject to the same criticisms: that weight gain may not reflect accurately the change in lean body mass. This difficulty may be circumvented in part by measurement of the urinary creatinine output over a timed period, since it is accepted that this provides an index of muscle mass. Measurement of height or body length over a long time is of even greater significance, particularly in older children, because height is usually less variable than weight. However, since height increases more slowly, the measurements have to be made over a fairly long period. Measurement of arm circumference has also been considered a useful indicator. The investigator should not neglect general observations such as the character of stools, amount of flatus, occurrence of allergic and other undesirable responses and general acceptability to mother and child.

2.2.3 Age and type of subjects. Since growth is faster and protein requirements are higher at an earlier age, greater advantages are obtained by using infants and young children, rather than older children, for measurements of protein quality. The children should be as normal as possible. Each investigator should determine the populations suitable for growth studies, but it is recommended that children who are frankly retarded in growth should not be studied because of great variabilities in responses. It is suggested that all children should be above the third percentile in height and should have weight-for-height above 95% of ideal, based on standards for well-nourished children (4).

In testing a new protein, it is important to find out which is the lowest age at which the protein supports adequate growth. Consequently the age will vary, depending on the results obtained from the initial tests. Weaning foods should be tried first in children of 6 months to 2 years. Substitutes for mother's milk should be tested in infants under 6 months but no new product should be tested on infants before having been shown to be safe in older children.

2.2.4 Duration. The duration of the trial must depend upon the extent to which constant conditions can be achieved. With infants aged about one year, under close supervision in a hospital ward, a reasonably accurate measurement of growth rate can be obtained by daily weighing over a period of 2 to 4 weeks. With somewhat older children, again under well-controlled conditions, e.g. in an orphanage, 3 to 6 months are necessary. Day-care centers, orphanages and convalescent hospitals for children are likely to be convenient for such studies. It has been observed that children do not gain appreciable weight during the hottest months of the year, when temperatures reach 38°C - 40°C, so that short-term trials in such

an environment should be avoided during these months. Similarly, epidemics of any infectious disease will invalidate trials.

2.2.5 Number of subjects. This will depend on the age and cooperativeness of the subjects, the duration of the trial, the extent to which infections and other interfering factors can be eliminated and the adequacy of the controls. Valuable information may be obtained from as few as five infants per group in a well-controlled study in an institution. For children between one and two years, both the experimental and the control groups should consist of at least 10 to 15 subjects, with as little variation in age as possible within the group. For preschool children, there should be at least 20 subjects in each group.

2.2.6 Frequency of observations. In studies on infants under hospital conditions, weights should be measured weekly, biweekly or monthly, depending on the age group and the duration of the trial. In infants length should be measured biweekly, but in older children height measurements at intervals of one to three months will be enough (5).

2.2.7 Level of feeding. The trial will not be a true test of protein value if other elements in the diet are limiting. The diet must therefore supply an adequate intake of calories, from fats and carbohydrates, and of vitamins and minerals.

The total protein intake should at least conform to the recommended allowances of FAO/WHO (3). The extent to which it may be higher than this depends upon the purpose of the trial; whether it is to determine the effect upon growth of a given protein supplement or whether it is to find the minimum amount of a protein mixture which will support normal growth.

In general, the test protein should be the sole source of protein in the diet; for some special purposes it may be provided as a supplement to a natural diet. The control group should preferably receive milk or egg as the source of protein, with levels of protein and calories adjusted to be comparable. When milk or eggs are not available in sufficient quantity, protein intake could come from vegetable mixtures established to be of high nutritive value.

2.3 Nitrogen balance measurements

The measurement of nitrogen balance in man is comparable to that of NPU in experimental animals.

2.3.1 Conditions. Staff and facilities must be adequate for the precise control of food intake, minimizing of cross-infections, complete collection of urine and feces and the necessary biochemical analyses. Experienced full-time personnel dedicated to the work are required for preparing and weighing the diets and giving close continuous supervision to the subjects. Because of the constant and monotonous diets, special skill is needed to ensure that the intake is maintained throughout the period of observation.

2.3.2 Subjects. Infants and young children who are fully recovered from malnutrition are good subjects, but children recovering from malnutrition are not suitable for such studies. It is also extremely important that the subjects have no infection. Even mild infections induce a stress response which increases urinary nitrogen loss.

Most malnourished infants are not likely to reach a stage at which the tests can usefully be done until they have received optimum treatment for one to two months. Complete nutritional recovery must be estimated not only by normal weight-for-height and serum and blood biochemistry but also by adequate lean body mass for height (refer to 2.4.2). It is difficult to specify an exact age range for such tests. Children from six to thirty-six months are convenient subjects, but this does not exclude children outside this age range. If groups are used they should be carefully matched. This is necessary because with recovery from depletion, nitrogen retention tends to fall. The best plan is to use each subject as his own control, with consecutive tests on control and experimental diets. Because the subjects may vary in degree of depletion as the tests go on, the order of feeding should be varied.

Young adult volunteers make excellent subjects because they can be fed at low levels of protein intake at which utilization of protein is maximum. They are available for long periods of time and hence can serve as their own controls and offer intelligent cooperation.

2.3.3 Food.

2.3.3.1 Calories, water, vitamins and minerals

The calories supplied must be equal in all balance periods, test and control, which are being compared and should meet the level recommended by FAO/WHO (3). The proportion of fat to carbohydrate and the nature of the fat must be similar in groups which are being compared. Water, vitamins and minerals, including potassium and phosphorus, should also be fed in adequate and constant amounts.

2.3.3.2 Protein level

Infants and children: For tests of protein value, the protein must be fed at a level or levels on the linear part of the curve of the nitrogen balance index (3,6). This curve remains linear for some way into the region of positive nitrogen balance. In tests on human infants, it is undesirable to feed at maintenance level only. It is necessary to choose a level above maintenance that is enough to allow reasonable nitrogen retention and growth, but not so high that the efficiency of nitrogen utilization falls off so much that differences in biological value disappear. It has been shown (7) that in infants of about one year, the average requirement for maintenance is 100mg N/kg/day in terms of cow's milk protein and that almost all balances are positive at an intake of 130mg N/kg/day. From the evidence available it seems that the total obligatory loss of urine and feces nitrogen per kg of body weight is only slightly higher in infants than in adults. It is recommended that for measurement of protein value the intake should not exceed an upper level of 300mg N, i.e. slightly less than 2g protein, per kg per day. If the clinical condition of the child justifies feeding at lower levels, e.g. 1 to 1.5g protein/kg/day, differences in protein value will be shown still more clearly.

A test at one level within the limits just specified is adequate if the sole concern is the measurement of protein quality. However, a further practical question may arise: can a food which has a poor protein value produce adequate retention and growth if fed at a higher level, e.g. 3g protein/kg? To answer this question, tests must obviously be made at whatever level is indicated by the measurement of biological value, but it should be clearly recognized that tests at such high levels are not reliable measures of protein quality.

Adults: To obtain a measure of maximum protein value in adults comparable to those obtained with children or growing animals, it is necessary to feed a level of protein intake well below requirements and to be certain that the individual is adapted to this level. In practice, a one-day, nitrogen-free period followed by 5 days at 0.3g protein per kg body weight is sufficient (8). The results of two subsequent consecutive five-day balance periods with the control diet are compared with similar periods with one or more test diets. Eight to ten subjects are generally sufficient and the 15-day periods on experimental and control diets should be randomized. Calories should be adequate to maintain body weight on the usual diet (8).

2.3.4 Adaptation period. The number of days required for initial adaptation depends upon the age of the subject and the magnitude of the change in quantity and quality of protein from that of the preceding diet. In infants a three-day adaptation period is generally sufficient, but in older children and adults five days or more may be needed. The individual investigator should provide evidence that the adaptation period used under his conditions is adequate. Subjects recovering from an infection may need one to two weeks before the nitrogen excretion is stabilized.

2.3.5 Length of balance period. Collections should be obtained for a minimum of six days. Two three-day periods or, if defecations are sufficiently frequent, three two-day periods represent a minimum study. Where circumstances permit, balances can be conducted over a period of two to three months

in such a way that 6 to 9 balance periods of six days each may be obtained in a single child.

2.3.6 Digestibility. In boys, separate collection of urine and feces will make possible measurement of apparent digestibility as well as of apparent biological value. With many vegetable proteins, digestibility is low and the measurement of it is therefore important. In girls, even if feces and urine cannot be adequately separated, it is still possible to measure the net protein utilization (NPU).

It is not generally necessary to measure the basal or "endogenous" urinary and fecal nitrogen loss in order to estimate the true digestibility and biological value. For practical purposes it is probably accurate enough to use the published figures (9). It is important, however, that the calculated nitrogen intake be verified by actual analyses of aliquots, since values from food composition tables do not give a sufficiently reliable estimate for the purpose.

2.3.7 Necessary precautions. In summary, nitrogen balance measurements will be useful, reliable and reproducible if the following precautions are observed:

a) Calorie intake per kg is adequate and constant.

b) Protein intake per kg is kept constant within a single trial.

c) There are no complicating vitamin or mineral deficiencies.

d) Water intake is controlled and excessive sweat loss avoided.

e) No infections, even of seemingly mild degree, are present.

f) Subjects are reasonably content and not psychologically disturbed.

g) The subjects are in an adequate state of nutrition and receiving protein levels which allow discrimination of protein quality.

h) Adequate adjustment periods are used.

i) Mealtimes are standardized both between and within treatments.

j) Period(s) on the same diet are long enough to determine trends as well as the initial response to dietary change.

k) Food intake and collections of urine and feces are obtained and measured accurately.

2.4 Other useful measurements

2.4.1 Serum albumin. In children recovering from malnutrition, changes in albumin concentration may give a rough indication of protein quality. Measurements should be made periodically and the blood sample should be taken at the same time in relation to meals.

Standardization of laboratory methods is desirable. Divergence of results for serum albumin and for growth and nitrogen retention have been reported. In some cases this appears to be due to a rapid increase in lean body mass and blood volume concealing active albumin synthesis (10) unless total circulating albumin is measured. Serum albumin also apparently behaves differently from other parameters in response to vegetable as compared to animal protein and is slow to increase on some experimental diets with low PER. The significance of this difference requires further study.

2.4.2 Creatinine/height index. It has recently been demonstrated that 24-hour creatinine excretion of a malnourished child compared with that of a well-nourished child of the same height is a good measure of the reduction of lean body mass due to malnutrition and its recovery with refeeding (11). It can be used to evaluate the degree of recovery of lean body mass.

2.4.3 Plasma amino acid and enzyme levels. Measurements of plasma amino acid levels and ratios and of the concentrations of various enzymes in the plasma have been proposed as useful tests. These methods still require further evaluation.

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TEXTURIZATION : VEGETABLE PROTEINS*

by A. D. Odell, Industrial Grain Products Ltd., Montreal, Canada

Industrial activity in all aspects of vegetable protein texturization is increasing rapidly, spurred by high meat prices, avid interest in meat extenders as a result and the existence or imminence of regulatory permission for such end uses in retail consumer markets in both Canada and the U.S.A. Soy protein has continued to receive the most attention in North America, while wheat gluten, soy and gluten-soy combinations are exploited in Japan. Other agricultural crops are under study and test in the United Kingdom and elsewhere. Increasing attention is being given, in the more northerly latitudes, to beans other than soy and to rapeseed and sunflowerseed. It is predictable that the next five years will show both breeding and processing progress which will permit broader use of currently marginal

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protein sources such as rapeseed. The meat price squeeze, the school lunch program use of soy extenders in the U.S.A. (USDA FNS 219) and the increasing recognition that nutritional value and freedom from toxic contaminants are all-important and that genetic origin of the protein is not, are combining to induce rapid acceptance of textured vegetable proteins in affluent societies, with inevitable beneficial impact on the nutritional needs of the less fortunate. One index of interest and opportunity is that approximately twenty major firms in the U.S.A. alone are now engaged in the manufacture of textured vegetable protein products in one form or another (1).

Although a relatively small number of commercial firms in various locations are pursuing wet-spinning approaches to texturization, this sophisticated and relatively expensive technique has had little major impact as yet and may well prove to be of only marginal practicality in a certain few developing nations where special situations exist. Capital costs, process control and other product parameters seem likely to continue to restrict this elegant approach to meat analogs to the higher levels of discretionary income.

The vast majority of textured products currently available are produced by various versions of high-temperature, short-time extrusion and/or expansion puffing of protein doughs or moist powders, based usually on fat-free soy meal or flour or combinations of them with other proteinaceous materials. Simple meat extension end-uses involve the rehydration of such textured materials to 60-65% moisture content before admixture with raw natural meats. Such extenders may be artificially-colored or natural, can and often do contain prescribed vitamin and mineral additives and when flavored to simulate the natural meat counterpart can serve as meat analogs.

The spectrum of products made possible by this technique goes far beyond meat extension and meat analogs, permitting the achievement of full-fat, stable flours, high-density "atole" beverages, weaning foods and CSM (corn-soy-milk)-type products to name but a few. Rather modest capital investment and low operating costs commend extrusion-puffing methodology to use by developing nations. The best performance, especially for meat extension, is achieved with low-fat flours, meals or flakes with a history of low-temperature processing, since dough plasticity due to undenatured protein is essential for proper texturization. Packaged hardware of high intrinsic versatility is available for exploitation of this technology at rather modest cost (2).

The positive aspects of this technology are reduction of beaniness and bitterness if these are inherent in the raw material, inactivation of enzyme and antienzyme systems, reduction in bacterial and mold loads to give enhanced shelf stability, elimination of hemagglutinins and gelatinization of starch content.

Product flexibility is ensured by the ability to premix ingredients to achieve desired amino-acid patterns, minimal nutritional damage due to short-time/high-temperature exposure, the survival of encapsulated vitamins and choice of end-product functionality by control of processing pH.

The feasibility of such methodology has long since been determined. Practicality, given the availability of suitable food-grade raw materials, then becomes a question of cost per unit product. An equipment manufacturer (3) cites processing costs per pound of $0.013 to $0.017, for production units capable of hourly rates of 2200 pounds and 3400 pounds. These are costs in the U.S.A.; individual cases would need separate analysis. Raw material costs added to these processing costs should include a 15% overuse factor.

The most practical approach to such a technology resource is on an "add-on" basis to an existing manufacturing plant where energy services are available. Powerful success determinants are availability of suitable raw materials, ease of penetration of the existing food chain and local receptivity to novel products.

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RAPESEED PROTEIN CONCENTRATE FOR HUMAN CONSUMPTION*

by Ragnar Ohlson, AB Karlshamns Oljefabriker, Karlshamn, Sweden

Rapeseed protein concentrate (RPC) is the processed product prepared from rapeseeds (Brassica napus, L. or Brassica campestris, L.) using sanitary food-processing practices. It is a bland, defatted protein concentrate containing more than 65 per cent protein for use in food products such as bread and other bakery products, breakfast cereals, ground-meat products, sausages and other meat products. It is produced from fully-ripened, high-quality rapeseeds that have been thoroughly cleaned to remove foreign material and damaged seeds. The moisture content of the seed is kept lower than 8 per cent and the content of free fatty acids in the oil is less than 1.5 per cent.

The new process developed at Karlshamn, Sweden

At Karlshamns Oljefabriker, in cooperation with Alfa-Laval AB, Tumba, both Swedish companies, a process has been developed for the production of a nontoxic, bland, light-colored protein concentrate for human consumption from rapeseeds.

The main objection to the use of rapeseed protein, both for human consumption and for animal feed, has been its content of glucosinolates. In the new process the content of glucosinolates in the concentrate is reduced to less than 1.5mg/g, which corresponds to a content of less than 0.5mg/g of oxazolidinthiones plus isothiocyanates, the hydrolysis products of glucosinolates. The concentrate has a protein content of about 65% on a dry weight basis (N x 6.25).

The unique feature of the process comprises four main steps:

1. Crushing the seeds in a roller mill so that the seedcoats are loosened without too much disintegration of the meats, followed by separation of the meats and the coats.

2. Inactivating enzymes such as the myrosinases, which are responsible for the enzymatic hydrolysis of glucosinolates to the antinutritional vinyloxazolidinthiones and isothiocyanates, continuously in the wet state at a temperature of about 100°C.

3. Water extraction of the glucosinolates at ambient temperatures or above, in a specially-designed countercurrent apparatus, involving 4-8 steps. The number of steps used is partly dependent on the original glucosinolate content of the seeds. Besides glucosinolates, soluble carbohydrates and some nitrogen-containing substances are removed from the seed meat material.

4. The extracted seed meat is dried in suitable equipment, e.g. a fluidized-bed drier or a flash drier. The oil in the dried material is recovered either through direct solvent extraction or by prepressing in an expeller press, which lowers the oil content from 60% to about 15-20%, followed by extraction with hexane of food-grade quality. The remaining rapeseed protein concentrate is freed from solvent traces under mild conditions, preferably in a "flash desolventizer" or "vapor desolventizer", so that destruction or discoloration of the protein is avoided.

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*Submitted as a background document for the 21st PAG Meeting, New York, 4-8 June 1973. PAG Document 2.38/5.

The RPC is produced in a yield of up to 30%, contains about 65% protein (dry weight basis), 0.5-1% oil, and has a glucosinolate content of less than 1.5mg/g. It is bland, with no objectionable taste or odor, and is light tan in color.

Yield

Seed coat fraction	12-15%
Fines	3-10%; useful, with good results as animal feed
Dry matter from evaporated extraction water	13-16%
Oil	35-42%; good quality, for edible purposes
RPC	23-30%; for human consumption

Composition

Because preparation of rapeseed concentrate is still in the developmental stage, quality characteristics including composition have not been definitely established. The composition data given below are preliminary and could, for example, vary with the raw material source.

TABLE I. COMPOSITION OF RPC

(per cent by weight, moisture-free basis)

Protein	59(N x 5.7) or 65(N x 6.25)
Fat	< 1
Carbohydrates (excluding fiber)	26
Crude fiber	7
Phytin	5
Total ash	7
Glucosinolates	0.15

TABLE II. ESSENTIAL AMINO ACID COMPOSITION

Amino acid (g/16gN)	RPC	Defatted soybean flour (1)	FAO reference protein (1957)
Isoleucine	4.1	4.4 - 4.9	4.2
Leucine	7.5*	7.2 - 7.9	4.8
Lysine	6.0	5.4 - 6.7	4.2
Phenylalanine	4.1	4.6 - 5.4	2.8
Tyrosine	2.8**	3.4 - 3.8	2.8
Cystine	3.1	0.8 - 1.6	2.0
Methionine	2.0	1.2 - 1.5	2.2
Threonine	4.4	3.6 - 4.2	2.8
Valine	5.2	4.0 - 5.2	4.2
Tryptophan	1.6	0.9 - 1.4	1.4

*The lysine content varies from 5.7 - 6.3 or higher.

**The cystine content was 3.1 after oxidation with performic acid.

As can be seen from this table, RPC has a good amino acid composition, with especially high values for the sulfur-containing amino acids.

TABLE III. BIOLOGICAL VALUES

PER (2,3)	2.8 - 3.8 (2.5 - 3.0 when adjusted to casein = 2.5)
NPU (4,5)	78
Biological value (4,5)	92
Digestibility (4,5)	86

TABLE IV. NUTRITIVE VALUE OF RPC WHEN FED IN COMBINATION WITH OTHER FOODS

Per cent of the protein from	PER
25% RPC + 75% meat meal (fat-free)	3.0
25% RPC + 75% wheat flour	1.2
45% RPC + 55% rice flour	2.6
27% RPC + 73% corn flour	1.9

The PER value of meat was 3.1. The PER value of RPC was 2.8 (when adjusted to casein = 2.5) in this experiment, due to the low lysine content (5.7g/16gN) of the batch. This of course also influences the supplementation values.

Functional properties

In order to obtain high acceptability for a new protein concentrate as an ingredient in foods it must have good functional properties, a fact which is often overlooked. Rapeseed protein concentrate has been compared to soy protein in its functional properties, the most striking being high water-binding capacity and its freedom from off-flavors when used in foods.

The water-absorption capacity of RPC is 500-700% as compared to 400% for Texgran (Swift & Co., texturized soybean flour), and its water-binding capacity is 300-400% as compared to 200% for Texgran. RPC can be used at 2-3 times higher concentration than soybean protein in different foods without any detectable off-flavor. The solubility of the protein in RPC is low, comparable to that of heat-treated soybean products, and the emulsifying and foaming properties are the same as for those products.

TABLE V. NITROGEN SOLUBILITY INDEX (NSI) FOR DIFFERENT PROTEIN PRODUCTS

Protein	NSI in 0.2M NaCl at 25°C	at 75°C
RPC	13	22
Texgran	14	15
SFP (Swift Food Protein)	5	5

Microbiological and storage properties

Rapeseed protein concentrate, as prepared, is free of *E. coli*, *Salmonellae* and other pathogens, with a total bacterial plate count of less than 20,000 per gram. The product was found to be stable and does not develop any off-flavors or odors or deterioration of protein quality when stored in a moisture-vapor-proof packaging material for six months at 40°C (104°F). Storage conditions should be such that direct heat is avoided and the packaging material used should be such as to withstand all the stresses of normal handling during storage and shipment.

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THE TECHNICAL ADVISORY COMMITTEE (TAC) OF THE CONSULTATIVE GROUP ON INTERNATIONAL AGRICULTURAL RESEARCH

by B. N. Webster, Development Dept., FAO, Rome

The following summary* relates to discussions relevant to protein production conducted during the fourth and fifth meetings of the TAC, which were held in August 1972 and February 1973, respectively. A summary of discussions at the first three meetings of the TAC was given in PAG Bulletin Vol. III, No. 1, 1973.

1. Perhaps the most significant single development was the decision by the TAC to appoint a standing Subcommittee on Grain Protein. This decision was based on a recommendation of the TAC's Grain Legume Subcommittee, which had felt some concern over the need to establish a mechanism both to coordinate properly present research work on grain legume and cereal protein improvement being conducted at various international and regional centers and to maintain TAC's awareness of current and future problems and possibilities for research in the general field of sources of grain protein for human consumption. The new Subcommittee has four members, one of whom is also a member of the PAG.

The Subcommittee, with the assistance of the TAC Secretariat, will prepare periodic briefs reviewing both the principal publications on protein needs, including those of the PAG, and major cereal and legume research programs, operational and contemplated, recommended for meeting those needs.

Recognizing the expertise already accumulated in the PAG and its Secretariat which would be relevant to the above task, the Secretariat of the TAC has sought the views of the PAG Secretariat regarding an appropriate methodology to be followed and the possibility of inputs from, and other forms of collaboration with, the PAG.

It was recommended that a general review of the principal legume research program be undertaken, to be followed by an outline survey of the present state of knowledge of the basic physiological aspects of grain legumes which might contribute to the seeming low-yield characteristics of these materials. On the basis of such a summary and review, initial guidance could be given the TAC on whether further action needs to be taken to encourage additional basic research on legume yields. Applied research on improvement of the main legume species should continue concurrently with any new basic research which might be considered. These recommendations of the Grain Legume Subcommittee were accepted by the TAC.

2. The Committee reviewed at its fourth meeting the annual program of work and budgets of the five established international research centers.

The program of the International Wheat and Maize Improvement Center (CIMMYT) placed considerable emphasis on maize improvement, including continuation of the program on development of high-lysine and -trytophan varieties. The TAC noted that application of the results of the maize program has been lagging somewhat in comparison with the wheat program. It was understood barley research was to be resumed in a modest way by CIMMYT, including the development of high-lysine varieties.

The Committee supported in principle an expanded program of the International Rice Research Institute (IRRI) which would be aimed at research on agricultural cropping systems, including rice in the rotations. This program had been conducted on a pilot scale, as reported previously, and had indicated the great advantages to be obtained by the inclusion of tropical tubers, legumes and other vegetables

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*Based on a document submitted by the TAC Secretariat, FAO, Rome, for use at the 21st PAG Meeting, New York, 4-8 June 1973.

in multiple-cropping systems and rotations. It also supported proposals for an expansion of the Institute's work on rain-fed rice, thus increasing considerably the rice acreages which might benefit from the development of improved and higher-yielding varieties with greater pest and disease resistance, for which good genetic material is already available.

The program of the International Institute for Tropical Agriculture (IITA) has been sharpened into two major lines of attack: crop improvement and farming systems improvement. Within the crop improvement program, the Institute is to continue its world-wide responsibility for research on cow peas, yams and sweet potatoes and has accepted regional responsibility for work on pigeon peas, to be supported by ICRISAT, and soy-beans, in collaboration with recognized centers such as the University of Illinois. This is in addition to the already-reported regional work on maize, rice and cassava, supported by CIMMYT, IRRI and CIAT, respectively.

Exploratory work is also being undertaken on three other legumes of high potential, yam beans, winged beans and lima beans, and also on other tuberous crops, including the Irish potato in anticipation of collaborative work with CIP.

The farming systems program of IITA aims at giving leadership in farming systems research for the low-country humid tropics; although both CIAT and IRRI include farming systems research in their programs, such research is specifically associated with systems based on the commodities for which each Institute has primary international responsibility. The IITA program includes the following studies which are conducted to develop optimum systems of cropping for a long-term, sustained-yield rotation: identification of suitably-adapted crop varieties and determination of their yield potential in continuously-cropped soils; solution of problems of soil fertility and management; limitations imposed by pests and diseases; development of suitable mechanical techniques and machinery for continuous-cropping systems at the smallholder level; identification of optimum crop combinations to maximize economic returns; and examination of traditional practices and social organization to identify major constraints. The program will utilize and integrate the results obtained in the crop improvement program in various combinations and with constant monitoring. The control for comparative purposes will be the traditional shifting-cultivation system.

An important expansion has taken place in the work of the International Center for Tropical Agriculture (CIAT), the Center having taken responsibility for a major regional program of research on Phaseolus beans. An impressive collection of varieties has been amassed and is being added to constantly. Much of the collection has already been freed of viruses and materials are being made available to cooperating research institutions in the Latin-American region. The work on beef and cassava, already reported, is being continued. Virus problems militate against the formation of a world germ-plasm collection of cassava, but collaborative work with IITA in Nigeria should ensure wide testing of available materials. Emphasis on pasture regimes in the beef program underlines the importance attached to problems of animal nutrition, particularly the need to ensure adequate food supplies throughout the dry season.

The new International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) is being established at Hyderabad, India, and although installations are still under construction, work has started in the field on some of the crops to be studied by this Institute: sorghum, millets, chick peas and pigeon peas. The proposed relay and linkage work of ICRISAT with institutions in Africa, recommended by the TAC, will be reviewed by the authorities of ICRISAT once core programs are established.

The proposals of the International Potato Center (CIP) were given full support by the TAC which indicated that more emphasis might be given to work on adaptability to tropical regions and less to the rather more restricted Andean zone. Work is progressing on the accumulation of a world germ-plasm collection and on tapping the enormous reserves of potentially-valuable genetic material in the Andean region. The Committee recommended

attention to some of the pressing problems of storage and keeping qualities of the potato, noting that this might entail work on processing as well as simply improving the "shelf-life" of the tubers.

While unwilling to undertake a long-term commitment for the support of the Asian Vegetable Research and Development Center, Taiwan, the Committee recommended, unsuccessfully, financial support for the completion of the capital program. The Institute has adopted an important program, from the point of view of a region in which vegetables play a very considerable role in the diet. The Institute proposes to concentrate, in the first instance, on tomatoes, eggplants and mung beans. The latter, apart from a very high protein value, are thought to offer considerable scope for yield improvement. Sweet potatoes would form the principal research field among roots and tubers, but Irish potatoes would also be studied in collaboration with CIP. Work on leafy vegetables would include the Chinese cabbage and water convolvulus. While the TAC recognized the major importance of vegetables in the Asian diet, for both protein and other essential elements, reservations were expressed concerning the priority which might be accorded international support for research on vegetables compared to other demands on scarce resources. It was pointed out that many problems of calorie and protein nutrition had not yet been solved and that these should continue to be rated higher than mineral and vitamin deficiencies for some time to come.

3. Discussion of priorities in international research occupied much of the fifth TAC meeting. The consensus was that first priority should remain in the field of food production with emphasis on cereals and legumes, and particularly cereal quality and yield stability. The main gaps in food crop research were specified. Ruminant livestock, especially cattle, were rated next in importance; the food potential of aquaculture was also considered worthy of detailed study. A pragmatic approach to "industrial crops" was recommended, high priority being given to cotton and oilseeds, but doubts were voiced on support to industrial crops of interest to a limited number of countries, e.g. jute. Forestry was not rated as of immediate priority, although it is important in relation to land use, soil and water conservation, environmental protection, etc. The need for multidisciplinary systems research in connection with land-use planning, environmental management, agricultural diversification, etc., was suggested. Although alternatives to the international center approach have not so far been very promising, further study of the regional cooperative research program concept was urged. Additional external support was thought necessary at the national level to permit national organizations to both pull their weight in regional structures and to profit to the best advantage from the established centers. It was suggested that the Committee envisage a two-level approach on guidance to the Consultative Group, one in respect to research deserving international support and another in respect to second-level priorities for which aid might be sought from bilateral sources and international agencies such as FAO, UNDP, IBRD or a combination of these.

4. The Committee approved the terms of reference of the mission to be fielded by the TAC to study and report on the research needs of the Near East and North Africa regions, details on which were given in the summary of discussions of the first three meetings of the TAC.

5. Reviewing the summary report on the TAC mission on research needs for protein production in tropical America, the Committee noted the marked interest in the region for coordinated research programs. The Committee concluded that CIAT, in collaboration with other regional organizations such as IICA, should be requested to examine the possibility of the establishment of a regional research network on legume production and examine the possibility of holding a regional seminar or conference on beef production.

6. The Committee endorsed the recommendation of the task force on African livestock development for the establishment of a livestock production research center for Africa, which would concentrate on a systems approach to

problems of production and which would rely heavily on existing national and regional research strengths as components of a coordinated cooperative effort. No final decision was made regarding the location of such a center. It was agreed that the new center should be developed independently of the proposed immunological laboratory for the livestock diseases trypanosomiasis and East Coast fever (ILRAD), but with provision for some common membership of governing bodies and possible fusion in the future.

7. The establishment of an international network of genetic resources centers has been taken a stage further by the offer of the Director-General of FAO to make regular program provision for the proposed coordinating center. The TAC welcomed this decision and further noted the possibility of bilateral support for the three regional centers proposed for Turkey, India and Ethiopia.

8. The Committee reaffirmed its decision to hold a working group meeting on aquaculture, having earlier recognized the potentially important contribution to be made to protein supplies by cultivation of fish. The working group meeting will be held during 1973 and the terms of reference, which emphasize the need for a review of the status of research in this field, were approved by the Committee.

It will be noted that the Committee has maintained its earlier emphasis on raising the yield and improving the quality of staple food crops and livestock for which the major contribution will continue to be that of the international centers. There is nevertheless a welcome tendency towards the establishment of research networks, linking national efforts and those of the centers, and the strengthening of national efforts is therefore becoming more and more a subject for close consideration. Discussions are planned among FAO, UNDP, IBRD and the representatives of the international centers on ways and means of achieving complementarity of efforts aimed at improving national research capabilities.

NEW INFORMATION FROM THE M.I.T. CONFERENCE ON SINGLE CELL PROTEIN*

An impressive amount of new information was presented by speakers at the M.I.T. International Conference on SCP (29-31 May 1973) dealing with processing, industrial aspects, toxicological and nutritional considerations and marketing and utilization of these materials for animal and human food use. These presentations will be available later in published proceedings of the conference.

Status reports given at the conference on SCP projects and processes from a number of countries are discussed briefly below. It should be emphasized that, with a single exception, the plants have not been inspected by the PAG nor have samples of the SCP products been submitted or independently examined. Moreover, supporting data concerning safety or nutritive value have not been critically reviewed in relation to the recommendations of PAG Guidelines 6 and 7.

a) Tate & Lyle carob utilization project

Fermentation process. The organism is a mold isolated from rotting carobs and has been designated Aspergillus niger M-1. It is uniquely adapted to growing on water extracts of kibbled

*This material is contained in the report of the third meeting of the PAG ad hoc Working Group on Single Cell Protein (SCP) held in June 1973 (see page 6); the balance of the report will be published in the next issue of the Bulletin. Single copies of the complete report are also available from the Secretariat.

(coarsely ground) carob because of its enzyme complement, which includes tannases. The fermentation has been operated routinely in the U.K. in fermenters of 1000-, 3000-, and 5000-liter capacity, and in Switzerland in fermenters of 1500-liter capacity. A thousand kilograms of carob-grown M-1 mycelium have been produced for animal feeding tests. This material was produced by the identical process proposed for Cyprus. Numerous other smaller quantities of dried M-1 mycelium have been produced in the U.K. from carob extract over the past two years for quality assessment. This recent work has demonstrated the reliability and technical viability of the M-1 carob fermentation process.

Animal feeding. In addition to the tests carried out by Tate & Lyle, further feeding trials have been completed or are in progress at the Instituut voor Landbouwkundig Onderzoek van Biochemische Producten (ILOB), Wageningen, Holland, with the following results:

i) Initial acute toxicity tests on rats have shown no adverse effects.

ii) Two test groups of rats, 10 male and 10 female in each group, were fed mycelia as a sole source of protein at a level of 40% of the diet; the control protein source was soy meal. Body weight and feed intake were measured. The animals were sacrificed after 28 days and the weight and histological characteristics of the liver, kidneys, heart and spleen were determined. No abnormalities were noted.

iii) Currently, four groups of chicks are being fed mycelium at the 7.5% level. After 14 days, no apparent weight divergences or variations in Feed Efficiency Ratio have been seen. Subsequent tests will involve pigs and veal calves. Feeding tests on fish (trout) are under way in the U.K.

Economics. An up-to-date evaluation of total carob utilization, based on computer analyses, will be submitted shortly to the PAG Secretariat. The specific application of the Tate & Lyle process to a particular developing country, using a particular agricultural substrate, will be a matter for commercial negotiation in the private sector or between a relevant UN agency and interested governments.

b) ICI bacterial methanol-substrate process

Fermentation process. A fermentation process has been developed that utilizes a Pseudmonas microorganism and methanol as the carbon source. The objective is to produce a feed-grade protein suitable for livestock as a substitute for products such as fish meal or soy meal. The process is characterized by a number of features that contribute to economic feasibility. These include unusually high yields for a methanol-utilizing organism, a unique fermenter design of the air-lift type and cell collection based on agglomeration. There is no problem of residual substrate contamination of the SCP product after drying because of the highly volatile nature of the substrate.

Animal feeding. The product has been chemically analyzed and contains approximately 85% crude protein (N x 6.25), 16% nucleic acids and 65% of the total cell dry weight content as amino acids by acid hydrolysis. The material has been tested in broiler and pig diets from a nutritional standpoint and in rats for toxicological properties. Levels up to 10% have been included in poultry and pig diets with no deleterious results and no negative effects have been seen in 90-day rat feeding trials. Additional animal trials are contemplated.

c) PEKILO - protein project

Fermentation process. The production and animal testing of a SCP product (PEKILO - protein) in Finland was reported by a representative of Oy Tampella. This organization is licensed to develop and sell the process for animal feed production. The microorganism, a member of the genus Paecilomyces, is a highly mycelial fungus. It is grown in continuous culture under strict aseptic conditions on bisulfite spent liquor from pulp mills, stripped of SO_2 and neutralized with calcium hydroxide. The product is reported to contain 60% crude protein (N x 6.25) and between 11 and 12% nucleic acids. It is separated by filtration, dewatered by pressing and flash-dried.

Animal feeding. The product has been experimentally fed to pigs, calves, poultry and rainbow trout by the Finnish Agricultural Research Center and it has been accepted by the Government for use as a protein feedstuff in Finland.

Plant location and size. A 10,000-ton per year production facility is being designed and constructed for operation at the United Paper-mills, Ltd., in Jamsankoski, Finland.

d) Microfungal product from the Lord Rank Research Centre, England

At its second meeting in Moscow in June of 1971, the ad hoc Working Group considered the data then available on a filamentous micro-fungal product grown on a substrate of molasses or starch and intended ultimately for food use. The group was impressed at that time with the favorable information on its acceptability and nutritional value for experimental and farm animals as well as its functional properties. Considerable additional data were presented at the MIT Conference on the technological aspects of the process and the favorable results of further feeding trials with calves, swine and poultry. Information was also presented on the feeding of baboons using large quantities of the product for an extended period. The animals accepted the feed well and behaved normally throughout the trials. Upon necropsy, there were no abnormal gross or microscopic abnormalities in any of the wide range of tissues examined. Clinical trials are contemplated in the near future. As a component of processed foods, the product is notable for its contribution to the textural characteristics and protein content of such foods.

e) Yeast protein produced by the British Petroleum Company

Extensive composition and biological data on a Candida yeast grown on gas oil in its pilot plant in Cap Lavera, France, were presented to the ad hoc Working Group at its first meeting in Marseille, France, in April of 1970.

The process is not a sterile one and about half of the cells in the final product are bacterial, although their volume is insignificant. At that time, a production plant of 20,000-tons annual capacity was under construction. This plant is now in production and the material is beginning to be used in practical animal feeding.

During the conference at MIT, extensive biological data were presented for the first time on a material produced in the British Petroleum plant in Grangemouth, Scotland, using the same organism, a Candida species, but employing a sterile process and using a highly-purified normal (straight-chain) alkane fraction as the substrate. The data presented included acute, subacute and chronic toxicity studies with rats, carcinogenicity and multiple generation studies with rats and farm feeding results with broilers, growing pigs and calves, for both Grangemouth and Lavera materials. All of these results were satisfactory and the company is going ahead with the production of both materials for sale as animal feed in the European Common Market. It has announced plans for a 100,000-ton per year plant to be built in Sardinia to utilize a gas-oil substrate.

f) The industrial production of yeasts from n-alkanes in the Soviet Union

Intensive investigations have been carried out in the U.S.S.R. on many potential sources of microbiological protein, including yeasts, bacteria and algae, with special emphasis on hydrocarbon-grown yeasts.

Major technological projects for the large-scale production of hydrocarbon yeast have been developed. A plant of approximately 200,000 tons per year capacity based on hydrocarbons is being constructed for the production of fodder yeast.

Biological studies are reported to have been carried out in the Soviet Union in both medical and agricultural institutions with the feeding of hydrocarbon-grown yeasts to many thousands of agricultural and experimental animals including rats, dogs, monkeys, rabbits, guinea pigs, pigs, cows, sheep, hens, turkeys, pond fish, etc.

Analyses are said to have been carried out for

protein, amino acids, nucleic acids, triglycerides and fatty acids; detailed identification of different toxic substances in hydrocarbon yeast apparently has also been attempted. Many different hydrocarbon yeast samples were studied, and it is claimed that the biological qualities of the yeast product were found to improve with improvement in the technology of manufacture. The reported presence in hydrocarbon yeast of a comparatively high content of fatty acids with odd numbers of carbon atoms is unusual for a natural foodstuff. Some accumulation of these in the tissues of experimental and farm animals was apparently observed with certain feedstuffs. This problem was said to have been overcome by rigid specification of the alkanes used as the energy substrate and methods of using hydrocarbon yeast in animal feeding.

Metabolic studies on rats have been done with labelled octadecane. This substance was reported to be absorbed quickly from the digestive tract, distributed in the tissues and gradually excreted from the test animal.

In multigeneration experiments with animals, hydrocarbon yeast was claimed to have a relatively high biological value with complete absence of carcinogenicity, mutagenicity and teratogenicity. Detailed investigation of hygienic, physicochemical and organoleptic properties of meats, eggs and milk from animals fed n-alkane yeast did not reveal any deleterious change. In long-term experiments to evaluate any influence of this meat as a food on the development of several generations of rats no abnormalities were reported in behavior, growth and development, protein, lipid and carbohydrate metabolism, activity of liver enzyme systems, or in hematological, morphological and histochemical factors.

These results would indicate that n-alkane yeast produced in the U.S.S.R. is an interesting prospective source of additional protein which may be particularly useful and effective in the feeding of farm animals. These data were reported to be the basis for initiating industrial-scale production of n-alkane yeast in the Soviet Union for animal feeding.

Large-scale controlled investigations of the influence of the systematic consumption of products from animals fed on hydrocarbon yeast was carried out on a large group of human volunteers. Two feeding trials were carried out, each lasting more than six months and with groups of more than 100 persons. These investigations apparently confirmed the high safety and nutritional qualities of these foodstuffs and the absence of any undesirable effects.

g) SCP projects in southern Italy

Liquichimica Biosintese S.p.A. of Italy has announced the construction of a 100,000 ton per year plant near Reggio Calabria in southern Italy, using the Japanese Kanegafuchi process in combination with the production of citric acid, amino acids and fatty acids. No additional details are available at this time, but the company is sponsoring an international symposium on SCP in Rome in November 1973 at which further information will be presented. There are also proposals for a collaborative project of British Petroleum to build a plant in Sardinia, Italy.

h) Solid waste utilization

Solid wastes represent an important potential source of carbohydrate substrates for SCP production. For example, 2.3×10^9 tons of solid agricultural wastes are produced in the United States each year. Of this, nearly 10^9 tons come from animal feed-lot wastes (manure). The trend is toward large feed lots with 10,000 to 100,000 animals, and a feed lot containing 10,000 head of cattle has a substrate potential for between 15,000 and 30,000 tons per year of SCP, depending upon the amount of pretreatment of the fibrous waste required. Typically, the fibrous portion of feed-lot waste runs from 30% to 75% cellulose; pretreatment with 0.05M NaOH at 23°C for 20 hours is necessary to achieve 75% microbial utilization of the cellulosic material.

The General Electric Company has reported

on a thermophilic actinomycete that is capable of rapid digestion of treated feed-lot fibrous waste and contains 30% to 55% crude protein (N x 6.25) on a dry basis. A demonstration plant at Casa Grande, Arizona, U.S.A., is now being modified to provide sufficient quantities of SCP for large-scale feeding trials. Some of the original problems encountered, which indicated the need for process modification, included air-borne mercury and phage contamination.

i) Biological effects of lignosulfonic acids

Research at the Veterinary College of Norway in Oslo has shown that lignosulfonic acids are commonly found in microorganisms grown on sulfite waste liquor. The significance of this finding to SCP safety has not been established, but the information should be considered in the light of evidence that lignosulfonic acids inhibit the growth of pigs when fed at concentrations of 13% in the diet. Lower concentrations of 3% and 6% did not produce any growth inhibition.

It also appears that commercial samples of yeast grown on sulfite liquor may contain significant concentrations of residual sulfite. Consideration should be given not only to the biological effects of the sulfite per se, but to its possible effects on the stability of thiamine in foods into which the yeast is incorporated.

PROTEIN AND AMINO ACID COMPOSITION OF WORLD COLLECTION OF GRAIN SORGHUMS

This booklet contains data on the protein content, amino acid composition, plant height, days to flowering and catechin equivalent concentration (tannins) for 832 lines from the world sorghum collection. Copies may be obtained from:

Purdue-AID Sorghum Project
Department of Agronomy
Life Science Building
Purdue University
W. Lafayette, Indiana 47907, U.S.A.

ERRATUM

PAG Bulletin Vol. III, No. 2, page 39, last paragraph: the sentence
"The nitrate content of spinach is obviously of importance in this connection"
should read
"The nitrate content of spinach is obviously of interest in this connection".

A NOTE ON THE PROBLEMS IN FOOD TECHNOLOGY AND ACCEPTANCE OF METHIONINE IN FOODS*

by J. L. Gabby, Mead Johnson & Co., Evansville, Indiana, U.S.A.

The information available from the published literature is scarce on the subject of methionine and its use in food products, particularly from the point of view of the food technologist. Although there is still something of a question mark regarding the absolute requirements for methionine in the human, from the nutritionists' standpoint there has been a good deal of literature because of the general lack of methionine in vegetable proteins. It is probable that the human requirement is not nearly as high as that for experimental animals such as the rat. Human babies receiving proteins from soy and rice did just as well if not better than those on milk.

It has been rather generally accepted that methionine tastes bad. Milton Winitz in U.S. Patent 3,697,287 (1972) indicates that this may not be the case. He suggests that freshly-recrystallized amino acids be used and that the amount of decomposition products from the sulfur-containing amino acids is the important factor in the flavor of completely synthetic diets for humans. There is also a Japanese Patent No. 31,353/70 on the use of methionine to improve the taste of sodium glutamate-containing compositions and a British Patent No. 1,208,818 (1970) on its use as a seasoning material along with yeast preparations. It is possible that the break-down products of the sulfur-containing amino acids have pleasant tastes under certain conditions.

The amount of methionine necessary to supplement a protein like soy is really quite small. When working with a complete food, as in a baby formula, the percentage of the overall product is very small. Usually the flavor of a baby milk is not very important, because human babies seem to accept flavors that are unpleasant to adults. When working with baby formulas containing soy proteins, there are unpleasant flavors other than that from methionine, so its addition to the flavor is unimportant.

Again referring to the Winitz patent, he has related the flavor of sulfur breakdown materials to pH and has found that a low pH tends to improve the flavor of these sulfur compounds. He also uses sugars as his source of carbohydrates. This means that the two conditions that are best for covering the flavor from methionine are high sweetness and low pH.

Perhaps one of the most common and oldest examples of this theory is a gelatin dessert. While pure gelatin is not really bad, it usually is not very good in flavor since it is a partially hydrolyzed protein. However, when mixed with sugar, fruit acids, flavor and color it makes a delightful food. In cases like an infant formula where the acid cannot be used, sweetness can be of great assistance in covering unpleasant flavors.

There are no published data on the effect of heat or storage on methionine or products to which methionine is added. We have noted that sterilization of liquid products is not particularly good for proteins. This same situation exists for products to which methionine has been added. There is no evidence to indicate that methionine is any worse when added or when naturally present in the protein. After taking into consideration such things as the destruction of harmful enzymes and bacteria and the acceptable loss of value for improved flavor, the less heat used on a protein the better.

Thus far we have considered only flavor and stability of methionine as they affect its use

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*Submitted as a background document for the 21st PAG Meeting, New York, 4-8 June 1973. PAG Document 2.20/8.

in foods. Other factors are relatively unimportant since the amount used is always small, it is a pure white material and is quite readily dissolved in water. If methionine enhances the flavor of sodium glutamate or hydrolyzed yeast products, this may suggest ways to use it in foods for most parts of the world. Babies will take it anyway and now perhaps adults will take it as an adjunct to seasonings.

Ife, Nigeria

INTERNATIONAL SYMPOSIUM ON PROTEIN FOODS

This symposium on sources of protein foods was organized by the Protein Research Group of the University of Ife, and was held at Ile-Ife, Nigeria, on 11-13 April 1973. The symposium was sponsored jointly by UNICEF and some of the food industries of Nigeria. Participants included officials of the Government Ministries of Trade, Agriculture and Natural Resources, university staff, representatives of FAO, UNICEF, the International Institute of Tropical Agriculture (IITA) at Ibadan and selected food industries and scientists and technologists from the U.K. and the U.S.A.

Discussions centered on five major areas: the magnitude of the problem of protein-calorie malnutrition in the country, particularly in urban areas; increased production and consumption of protein-rich foods through better incentives to farmers, improvements in agricultural practices and better preservation, storage, marketing and distribution arrangements; development and wider utilization of local protein-rich foods; food fortification; and training and education in nutrition and food science.

The group urged a rapid increase in the production of processed foods to meet the taste, convenience and dietary needs of the rapidly-expanding urban population. To ensure that customary diets are balanced with regard to essential nutrients, it was recommended that steps be taken for intensive cultivation of nutritious indigenous food crops.

Reviewing reasons for the failure of a number of processed weaning foods developed in the country, the group stated that these foods were not familiar or acceptable to the majority of the population. Fortification of cassava products with amino acids, as in gari, was also found unwelcome.

Nutrition scientists, food technologists and the food industries were urged to be realistic and to identify and work for the development of low-cost weaning foods and protein-rich foods based on local foodstuffs familiar and acceptable to local populations. In this connection, the value of using local edible leaves for the preparation of leaf protein concentrate was mentioned.

The need for financial support from the Government for research and as an incentive to production, promotion and distribution of both weaning foods and other protein-rich foods was pointed out.

The paramount role of nutrition and food science education in plans to improve the food and nutrition situation in the country was recognized. The food industries were called upon to make a contribution to the training of food scientists and technologists by giving opportunities to obtain practical experience in the food industry during long vacations. A reexamination of the techniques of nutrition and food science education in the country was suggested.

A group composed of representatives of the Government, the universities and the food industries was set up to seek the commitment of Government institutions, the food industries, university departments and institutes, religious bodies and private investors in the fight against protein-calorie malnutrition in the country.

O. L. Oke

INTERNATIONAL COMMISSION TO CARRY OUT BROAD STUDY OF FOOD SAFETY AND SUPPLY

A group including distinguished experts from the scientific, medical, legal and consumer affairs fields has formed a public corporation to sponsor a major study of the scientific, legal and social factors affecting the safety and availability of the world's food supply.

Spokesmen for the group pointed out that concern for the safety of the food supply has led to regulations that vary between nations and even among states or provinces within a single country. These regulatory procedures and their effects should be examined in the light of experience to date in order to obtain the maximum benefits from the application of science and technology to the production and distribution of foods.

The study will involve distinguished international authorities from the fields of nutrition, food science, agriculture, medicine, toxicology, law, economics, the humanities and political science.

Dr. Charles C. Edwards, former U.S. Commissioner of Food and Drugs, recently urged that an international group be formed to initiate the study under nongovernment sponsorship. He pointed out the widespread and urgent need "to seek clearer guidelines for the decision-making process relative to many benefit-risk considerations. This need is especially great in decisions that crucially affect the food supply".

Representatives of several prestigious public foundations and organizations responded to Commissioner Edwards' call by forming a "Citizens Commission on Science, Law and Food Supply" to organize an International Commission which will examine and report on the societal benefits and risks that accrue from the application of science, technology and the law to the food supply. Dr. Frederick Seitz, President of Rockefeller University and a former President of the National Academy of Sciences, U.S.A., will serve as Chairman of the Board of Directors.

The headquarters of the Commission will be located in New York City because of the proximity of international organizations and several major foundations concerned with related world problems. Initial plans for the organization and implementation of the project are now being developed.

For further information contact:
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A PILOT STUDY ON THE FEASIBILITY OF USING MASS MEDIA FOR IMPARTING NUTRITION EDUCATION*

The pilot study under the auspices of the Protein Foods Association of India, Bombay, was launched in the State of Maharashtra, India, in September 1970 (see PAG Bulletin No. 11, 1971, p. 44) and was completed in August 1971. The PAG had an opportunity to review the results of the pilot study at its 21st Meeting when the agenda item on mass communication in nutrition improvement was under discussion.

* A summary of a paper submitted as a background document for the 21st PAG Meeting, New York, 4-8 June 1973.

The study was restricted to a single linguistic region and to people with a family income of Rs250/month (US$33) living in towns with a population of about 20,000. The campaign focused attention on the health and nutrition of children and the crux of the message was that protein is an important part of a healthy diet and that consumption of the right quality and quantity of protein is vital for the normal growth and health of children. The media used were the press, cinema, slide projection, street hoardings (billboards), information charts exhibited in institutions and public relations through opinion leaders.

It was found that the campaign had a strong impact on the target population. There was an understanding of the protein needs of the children and nearly a third of the mothers were also motivated to modify the diets of their children. There was a great demand for the free booklet entitled "Protein is life" in spite of the offer being hidden in the copy of the press advertisments.

Copies of the report may be obtained from:
Protein Foods Association of India
22, Bhulabhai Desai Road
Bombay 26, India.

UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP)
GLOBAL RESEARCH PROJECTS

1. Project designation: GLO/70/001
Title: Research and training in the development of high lysine maize
Recipient: International Maize and Wheat Improvement Center (CIMMYT), Londres 40, México 6, D.F., México.
Executive agency: UNDP
UNDP allocation: US$1,653,200 (1970-1973)

This project has been renewed for 1973-1976 under the title "Research and training in the development of high quality maize" (GLO/72/009). UNDP allocation is US$2,338,800

2. Project designation: GLO/71/003
Title: Research on single cell proteins from carob beans: toxicology and nutritional animal testing scheme of fungal protein (see PAG Bulletin Vol. III, No. 1, p. 45)
Recipient: Government of Cyprus, Nicosia
Executive agency: FAO
UNDP allocation: US$82,053 (1970-1973)

3. Project designation: GLO/71/007
Scope: The development of improved means of control of the tsetse fly, ticks, African army worms, mosquitoes and termites in ways which have minimal deleterious ecological effects
Recipient: International Centre for Insect Physiology and Ecology (ICIPE), Nairobi, Kenya
Executive agency: UNDP
UNDP allocation: US$3,198,690 (1972-1976)

4. Project designation: GLO/71/013
Scope: The development of lines and varieties of sorghums and millet, with both high yield and high content and quality of protein, as well as acceptable taste and kernel appearance and suitability for use in a wide range of ecological and farming conditions throughout the semiarid tropical regions
Recipient: International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), I-II-256 Begumpet, Hyderabad 500016, India
Executive agency: UNDP
UNDP allocation: US$2,917,000 (1972-1976)

5. Project designation: GLO/71/002
Title: Research on social and economic implications of large-scale introduction of new varieties of food grains
Recipient: Research Institute for Social Development (UNRISD), United Nations, Geneva, Switzerland
Executive agency: United Nations
UNDP allocation: US$470,300

THE ORGANIZATION OF AMERICAN STATES (OAS) REGIONAL SCIENTIFIC AND TECHNOLOGICAL PROGRAM

The OAS finances a grant program designed to strengthen the technical and research capabilities of Latin-American research institutes. Projects are being supported in Mexico, Central America, Colombia, Peru and Brazil. Recently, research centers in Ecuador, Paraguay, Costa Rica and Trinidad and Tobago have been included.

The food technology sector of the program has concentrated on two areas: tropical fruits; and starches, proteins and lipids. The starches, proteins and lipids project has covered studies on the following: avocado oil and coconut products; bread supplemented with flour from potatoes and sweet potatoes; starch gelatinization studies and milling and air classification of corn, cassava and plantain flours; cottonseed meal upgrading for consumption by monogastric animals; cottonseed protein isolation; safflower and sunflower meal studies and others.

A nutrition project has covered shorter and more specific topics and has been in operation for less than two years. It has included a systems approach to malnutrition; a comparison of several cooking processes for eliminating antinutritional factors in beans; introduction of legumes in children's diets; manufacture and evaluation of reconstituted milk for human and animal consumption; and use of coffee pulp for animal nutrition.

Another activity of the multinational project on food technology is academic training. A number of scholarships, about sixty so far, have been granted to Latin-American students, preferably from centers working in the food technology area, for advanced degrees in food technology, food science or food engineering at the Universidade Estadual de Campinas (Brazil).

STATUS OF FISH PROTEIN CONCENTRATE (FPC) IN THE U.S.A.*

The National Marine Fisheries Service's twelve-year FPC research and development program will be terminated soon. This decision has been made recently due to overall budget cutbacks and the expiration of the FPC Act (PL-89-701, as amended) on June 30, 1972. Arrangements are being made to dispose of the experiment and demonstration plant in Aberdeen, Washington State, and the product remaining from its operation. The National Marine Fisheries Service is at present engaged in compiling all information accumulated during the past years along with a detailed discussion of the state of the art and a description of the remaining unresolved problems. This will be available in about three months and copies may be obtained by writing to: Dr. George Knobl, Director, College Park Fishery Products Technology Laboratory, Regents Drive, College Park, Maryland 20740, U.S.A.

There is limited domestic interest in FPC within the industry. The emergence of a domestic industry is unlikely until the one-pound packaging restriction presently in the U.S. Food and Drug Administration regulations

* Prepared from a letter written by Joseph W. Slavin, Associate Director for Resource Utilization, National Marine Fisheries Service, U.S.A., to Marine Fisheries Review (May-June 1973, Vol. 35, p. 59), a U.S. Department of Commerce publication.

is removed. A petition to remove this restriction is before the FDA and a favorable disposition is expected shortly.

In regard to international interest in FPC, the proceedings of an international conference on FPC held in Cambridge, Mass., U.S.A. (June 1972) will provide a summary of the interest and activities of the many countries represented at the conference. Copies of the proceedings may be obtained from: Dr. S. R. Tannenbaum, Department of Nutrition and Food Science, Massachusetts Institute of Technology, Cambridge, Mass. 02139, U.S.A.

R. R. Puffer and C. V. Serrano: PATTERNS OF MORTALITY IN CHILDHOOD: REPORT OF THE INTER-AMERICAN INVESTIGATION OF MORTALITY IN CHILDHOOD

This work is the result of a coordinated research program undertaken by the Pan American Health Organization (PAHO) to determine causes of death in infancy and early childhood in the Americas using clinical data and all information available from hospital and autopsy records and home visits. The objective of the study was to gain a greater understanding of the epidemiology of diseases as a basis for health programs in the Americas. The design and methodology of the study described in the report were such that it enabled a precise determination of the causes of death in infancy and early childhood and helped in understanding the natural history of the prevalent childhood diseases both in the technologically-advanced countries, the U.S.A. and Canada, and the developing societies in South and Central America.

The investigation covered thirteen projects in Latin America (1968 - 1971) and two additional projects, one each in the U.S.A. and Canada (1969 - 1971). Six projects were urban and the rest encompassed rural, suburban and urban areas. The study covered data on approximately 35,000 deaths and was completed in a period of 27 months. The report provides detailed discussion on birth weights, childhood mortality at different ages, infant mortality, neonatal mortality, the nature of infectious diseases and nutritional deficiencies, their interrelationship and associated and underlying causes of death, congenital deformities, other diseases, reproductive patterns among women, breast-feeding practices, social and other environmental factors and available medical facilities. The report ends with a chapter on highlights of the investigation and recommendations for further study and action. There are several appendixes containing copies of the questionnaires, the tabulated data on mortality obtained in the fifteen projects, a bibliography and an index.

The report provides data which clearly show that nutritional deficiency is a serious health problem among young children and an important cause of death. The data also indicate a close interaction between malnutrition and infectious diseases. Nutritional deficiency was an associated or underlying cause of death in nearly two-thirds of the infants and children in urban and rural areas. Mortality due to nutritional deficiency was generally higher in rural than in urban areas. The role of infectious diseases as underlying causes of death was demonstrated, with diarrheal disease the principal cause and measles second in importance. The complex problem of childhood malnutrition, infectious diseases and high mortality was largely the result of poverty, low income, inadequate knowledge and poor sanitary facilities.

Puffer, R.R., and C. V. Serrano. 1973. Patterns of mortality in childhood. PAHO Scientific Publication No. 262. Pan American Health Organization, Regional Office of the World Health Organization, Washington, D.C., U.S.A. 470 pp. Price not quoted.

A. A. Albanese, ed.:

THE EFFECT OF MATERNAL NUTRITION ON THE DEVELOPMENT OF THE OFFSPRING

This is the proceedings of an international symposium sponsored by the Johns Hopkins University, U.S.A., and the Lord Rank Research Centre, England.

The symposium was held on 6-8 November 1972 at the Lord Rank Research Centre, High Wycombe, Buckinghamshire, England. Of the forty-eight participants thirty-three were from the U.S.A., nine from England and the rest from Taiwan, Switzerland, Ethiopia, Guatemala and Chile. The purpose of the symposium was to review current information in order to determine, in practical terms applicable to human populations, in what ways the quality of the maternal diet can influence the development of the offspring and to indicate further research to clarify this relationship.

Twenty-one formal papers with detailed discussions are included in the volume, which presents the subject matter in three sections. The first deals with the effects of maternal diet on the survival, growth rate, metabolic and physiologic functions and aging process in the offspring. The discussion on these was based on laboratory studies with experimental animals. This was followed by a review of results of animal experiments on the effects of calories and protein on growth, development and behavior, the significance of pre- and postnatal periods from the point of view of effects of nutritional stress and long-term persistent effects of maternal protein deficiency, including adaptations and abnormalities in several generations. The discussion in the final section was devoted to an assessment of the significance of these observations on animals to human population groups. Progress reports on studies of human populations in Taiwan, Guatemala and the U.S.A. were presented. The investigation in Taiwan is nearing completion and since the data are undergoing statistical treatment, the paper does not give any results except some preliminary indication of differences, not statistically significant, in birth weight and birth length of male infants born to the same mothers before supplementation and following supplementation in two consecutive pregnancies. The Guatemalan study on the relationship of birth weight, maternal nutrition and infant mortality revealed that calorie supplementation during pregnancy was associated in rural areas with babies heavier at birth. The mother's height and weight, an index of adequate nutrition in her early life, and her nutritional status preceding pregnancy were shown to have a great influence on birth weight. The study identified several other maternal and environmental factors related to the size of the infant at birth. A relationship was demonstrated in study villages between birth weight and infant mortality. It was noted that calorie supplementation during pregnancy reduced infant mortality by increasing the birth weight of babies. The results of a similar study in progress in New York City were not available.

The symposium underlined the need for carefully-planned clinical studies in several population groups, using different study designs and techniques, to unravel unequivocally the important effects of maternal diet on growth and development of human offspring.

Albanese, A.A. (ed.). 1973. The effect of maternal nutrition on the development of the offspring. Proceedings of an International Symposium held 6-8 November 1972 at High Wycombe, England. Published as a special issue of Nutrition Reports International, Vol. 7, No. 5, pp. 241-602 (May 1973). Special issue: US$8.00 if bought separately; annual personal subscription US$30.00.

Miloslav Rechcigl, ed.:

WORLD REVIEW OF NUTRITION AND DIETETICS, VOLUME 16

This volume is subtitled "Food, nutrition and health: a multidisciplinary treatise addressed to the major nutrition problems from a worldwide perspective". It is devoted to a series of reviews on the topics of nutrition and health, nutrition and disease and food and nutrition. Part I of the book presents five articles on various aspects of nutrition and health; nutrition in infancy, early childhood and during pregnancy; nutrition and aging; nutrition and physical performance; and nutrition and behavior and learning. Recent information is reviewed to bring out the significant role of nutrition in various physiological and developmental processes. Part II also contains five reviews dealing with the clinical, pathological, therapeutic and preventive aspects of common nutritional diseases. The first review describes all the nutritional and nutrition-related diseases, followed by articles on undernutrition, overnutrition and the relationship of nutrition to infection and oral diseases. Part III is devoted to some aspects of preharvest and postharvest food problems and those arising from food habits and food faddism. Topics covered are prospects of improving world food supply, food habits and faddism, food processing, food additives, food safety and food poisoning.

The last section, which forms Part IV of the work and was prepared by the editor, contains an extensive bibliography of reviews relating to food, nutrition and health.

The twenty contributors to this volume are from the U.S.A., the U.K., India, Jamaica, Lebanon, Mexico, South Africa and Sweden and many of them are internationally-known specialists.

Rechcigl, M. (ed.). 1973. Food, nutrition and health: a multidisciplinary treatise addressed to the major nutrition problems from a worldwide perspective. Volume 16 of World Review of Nutrition and Dietetics (G. H. Bourne, series ed.). S. Karger, Basel, Switzerland. 511 pp. US$55.80; £22.80.

A. W. Marsden, ed.:

WORLD ANIMAL REVIEW

The Food and Agriculture Organization of the United Nations began publication in 1972 of a new quarterly journal. It reviews developments in animal production, animal health and animal products and byproducts, with particular reference to Asia, Africa and Latin America. The journal is prepared by the Animal Production and Health Division of the Agriculture Department. Annual subscription rate is US$3.00 or £1.20.

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00100 Rome, Italy

MEETINGS

29 - 31 August 1973	THE CONTRIBUTION OF CHEMISTRY TO FOOD SUPPLIES (IUPAC - IUFoST) Contact: Dr. A. J. Collings Unilever Research Lab. Colworth House, Sharnbrook Bedford, England	Hamburg, Germany
18 - 19 September 1973	INTERNATIONAL SYMPOSIUM ON TRITICALE Contact: Dr. S. P. Yang Dept. of Food and Nutrition Texas Tech University P. O. Box 4170 Lubbock, Texas 79409, U.S.A.	Lubbock, Texas
29 October - 2 November 1973	IITA TROPICAL GRAIN LEGUME IMPROVEMENT WORKSHOP NO. 1 Contact: Dr. K. O. Rachie International Institute of Tropical Agriculture P. M. B. 5320 Ibadan, Nigeria	Ibadan, Nigeria
12 - 14 November 1973	WORLD SOY PROTEIN CONFERENCE Contact: Mr. R. W. Fischer 314 Main St. Cedar Falls, Iowa 50643, U.S.A.	Munich, Germany
4 - 11 December 1973	TECHNICAL CONFERENCE ON FISHERY PRODUCTS Contact: Dr. Rudolf Kreuzer Fisheries Industries Div. FAO, Rome, Italy	Tokyo, Japan
1 - 5 April 1974	CONFERENCE ON ANIMAL FEEDS OF TROPICAL AND SUBTROPICAL ORIGIN Contact: Public Relations C Tropical Products Institute 56-62 Gray's Inn Road London WCIX 8LU, England	London, England
15 - 18 May 1974	SECOND INTERNATIONAL SYMPOSIUM ON FOOD AND WORK Contact: Institut Régional d'Hygiène 40, rue Lionnois 54000 Nancy, France	Vittel, France

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PAG STATEMENTS AVAILABLE

No.	Title	Date	Published in PAG Bulletin
2	PAG Recommendation on aflatoxin	1969	
3	PAG Statement on the nature and magnitude of the protein problem	1971	No. 12
4	PAG Statement on single cell protein	1970	No. 11
5	PAG Statement on the marketing and distribution of protein-rich foods	1971	No. 12
6	PAG Statement on milk substitutes	1970	
7	PAG Recommendation on prevention of food losses and protein-calorie malnutrition	1969	
8	PAG Statement on plant improvement by genetic means	1970	
9	PAG Recommendation on amino acid fortification of foods	1970	
10	PAG Statement on a systems approach to the formulation and evaluation of nutrition intervention programmes	1970	
11	PAG Statement on leaf protein concentrate	1970	
12	PAG Statement on the world protein problem: research and development needs	1972	No. 12
13a	Review of the specific proposals contained in ACAST report "International Action to Avert the Impending Protein Crisis" United Nations, 1968	1971	
14	PAG Statement on marketing of conventional foods	1971	No. 12
15	PAG Statement on popular participation and community involvement in nutrition improvement programmes	1971	
16	PAG Statement on the potential of fish protein concentrate for developing countries	1971	Vol. II, Nos. 2 and 3
17	PAG Statement on low lactase activity and milk intake	1972	Vol. II, No. 2
18	PAG Statement on relationship of pre- and postnatal malnutrition in children to mental development, learning and behavior	1972	Vol. II, No. 2
19	PAG Statement on maintenance and improvement of nutritional quality of protein foods		
20	PAG Statement on the "protein problem"	1973	Vol. III, No. 1
21	PAG Statement on specifications for solvents	1972	
22	PAG Statement on upgrading human nutrition through the improvement of food legumes	1973	Vol. III, No. 2
23	PAG Recommendations for the promotion of processed protein foods for vulnerable groups	1972	Vol. II, No. 3
24	PAG Statement on the Green Revolution and protein supplies	1973	
25	PAG Statement on the global maldistribution of protein: a growing trend	1973	Vol. III, No. 3

PAG GUIDELINES AVAILABLE

No.	Title	Date	Published in PAG Bulletin
2	PAG Guideline for preparing food-quality groundnut flour	1970	No. 2
4	PAG Guideline for preparation of edible cottonseed protein concentrate	1970	
5	PAG Guideline for edible, heat-processed soy grits and flour	1969	
6	PAG Guideline for preclinical testing of novel sources of protein	1972	
7	PAG Guideline for human testing of supplementary food mixtures	1972	Vol. III, No. 3
8	PAG Guideline on protein-rich mixtures for use as weaning foods	1972	
9	PAG Guideline on fish protein concentrate	1971	No. 12
10	PAG Guideline on marketing of protein-rich foods in developing countries	1971	
11	PAG Guideline for the sanitary production and use of dry protein foods	1972	Vol. II, No. 3
12	PAG Guideline on the production of single cell protein for human consumption	1972	Vol. II, No. 2
13	PAG Guideline for the preparation of milk substitutes of vegetable origin and toned milk containing vegetable protein	1972	Vol. III, No. 1
14	PAG Guideline on the preparation of defatted edible sesame flour	1972	Vol. III, No. 1

PAG REPORTS AVAILABLE

1. Feeding the preschool child: report of a PAG ad hoc working group 1971
2. Manual on feeding infants and young children (Cameron and Hofvander) 1972

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No.	Título
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3	Naturaleza y magnitud del problema de las proteínas
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6	Sustitutivos de la leche
7	Prevención de las pérdidas de alimentos y la malnutrición proteinocalórica
9	Fortificación de alimentos con aminoácidos
10	Sistemas para formular y evaluar programas de acción nutricional
11	Concentrado de proteína de hoja
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LES DOCUMENTS SUIVANTS EN VERSION FRANCAISE SONT EGALEMENT DISPONIBLES

No.	Titre
4	Rapport sur les protéines obtenues par la bio-synthèse d'organismes unicellulaires
6	Directives pour les essais pré-cliniques des sources nouvelles de protéines
7	Directives pour les essais chez l'homme des aliments de supplément
8	Directives sur l'emploi d'aliments composés riches en protéines comme aliments de sevrage
12	Directives pour la production de protéines obtenues par la bio-synthèse d'organismes unicellulaires